MELIOLA

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SPECIES OF MELIOLA AND IRENE FROM BRITISH GUIANA AND TRINIDAD

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(WITH PLATES 1 AND 2)

Some of the species of *Meliola* and *Irene* collected by the senior author in British Guiana and Trinidad during the summer of 1922 are described in this paper. The route of travel, and the points where collections were made, have been recounted in a previous article [1] which also gives in some detail the floral and topographic features encountered.

Although only a portion of the specimens obtained are being reported they may be considered in some degree representative of the Island of Trinidad, and of the tropical part of South America visited, inland to a depth of about 150 miles. The remainder of the specimens will form the subject of a future paper.

We are using the distinction between the genera *Meliola* and *Irene*, as set forth by Theissen and Sydow,[2] as a convenient though admittedly artificial grouping of the species. A more natural grouping might be attained by using, as did Theissen [3] in establishing the genus *Amazonia*, the characters of the mature

[1] STEVENS, F. L. Parasitic fungi from British Guiana and Trinidad. Illinois Biological Monographs **8**: No. 3. 1923.

[2] SYDOW, H. & P. Beitrag zur Kenntnis der Pilzflora der Philippinen-Inseln. Ann. Myc. **15**: 165–(194)–268. 1917.

[3] THEISSEN, F. Ueber einige Mikrothyriaceen. Ann. Myc. **11**: 493–(499)–511. 1913.

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perithecium. The true nature of a perithecium is not, however, always apparent at maturity and the process of development would have to be considered in detail. Throughout the Meliolineae perithecia characteristically arise from capitate hyphopodia through a pseudoradiate proliferation of cells. This proliferation is confined, in the typical species, to the formation of spherical perithecia; but in atypical ones it is carried further in one or the other of two directions: First it may produce a dimidiate perithecium, almost truly radiate, with very evident similarity to true Microthyriaceae. Second, it may produce a spherical perithecium and a more or less compact, pseudoradiate hyphal subiculum. In the first case species of *Amazonia* result, while in the second case the species are similar to those noted especially by Spegazzini [4] in his recent monograph of Argentine Meliolas. Treatment of the genus on this basis would require, however, a detailed study of all its species—a task much beyond the scope of our paper. Several of the species which we are now reporting show marked intergradations between typical species of *Meliola* and the two atypical extremes.

The characters exhibited by the species we are reporting are such as to lead us to suggest that, contrary to the usual belief, spherical rather than dimidiate perithecia represent the pinnacle of development. It is conceivable that the impulse toward cell proliferation by such fixed structures as capitate hyphopodia would at first be diffused, resulting in the production of an abundance of mycelial strands of a purely vegetative nature and an indistinctive, flattened perithecium such as is found in *Amazonia*. The gradual definition of the proliferation impulse would result first in a submergence of the hyphal tendency and an accentuation of the perithecial tendency with spherical perithecia and loose pseudoradiate subicles as the result; but finally in a complete elimination of hyphal formation and an ultimate perithecium spherical in shape and lacking in any except the most meagre of hyphal connections.

In the following pages we have arranged species according to their hosts, in the host sequence of the "Genera Siphonogamarum" of Dalla Torre and Harms. But in the key, which

[4] SPEGAZZINI, C. Revisión de las Meliolas Argentinas. An. Museo Nac. Hist. Nat. Buenos Aires **32**: 339–393. 1924.

precedes the descriptive text, we have endeavored to bring similar species close together without reference to their host relations, and to point out the most tangible of separating characters, although of course these will not be wholly representative of their differences. To the description of each new species there is appended a "group number" which summarizes its salient morphological characters in the manner proposed by Beeli;[5] for old species this number, readily available in Beeli's article, has been omitted. The Beeli key, of which we speak frequently, is found in the citation just mentioned. Host determinations were made by N. L. Britton, of the New York Botanical Garden.

MELIOLA

(Mycelial setae present)

Perithecial and mycelial setae present ..... 10. *M. byrsonimina*
Perithecial setae lacking.
  Mycelial setae simple.
    Capitate hyphopodia definitely opposite, conical.
      Basal cells very short, 1.5–2 μ ..... 7. *M. conigera*
      Basal cells longer, 3.5–4 μ ..... 3. *M. angusta*
    Capitate hyphopodia alternate or less definitely arranged.
      End cells of the ascospores acute ..... 18. *M. olecranonis*
      End cells obtuse.
        Branching definitely opposite, though variable.
          Maculicole ..... 20. *M. gnathonella*
          Not maculicole.
            Setal tips often falciform ..... 12. *M. Euphorbiae*
            Setal tips straight.
              Setae short—up to 300 μ.
                Perithecia small, 90 μ or less. 11. *M. Manihot*
                Perithecia larger, over 100 μ.
                  Spores small, 22 μ long .. 19. *M. Lisianthi*
                  Spores longer, 30–40 μ.
                    Colonies extensive ... 2. *M. Coccolobis*
                    Colonies small, 3 mm. in diam. ..... 8. *M. Pithecolobii*
              Setae longer—400–1000 μ.
                Internodes 30–40 μ long .... 22. *M. Malaneae*
                Internodes much shorter ... 9. *M. byrsonimicola*
        Branching alternate, or indefinite.

[5] BEELI, M. Note sur le genre Meliola Fr. Bul. du Jard. Bot. de l'etat Bruxelles **7**: 89–160. 1920.

Ascospores clavate ..... 21. *M. amphigena*
Ascospores not clavate.
Mucronate hyphopodia long, 17–22 μ ..... 1. *M. Aristolochiae*
Mucronate hyphopodia shorter, 14–16 μ ..... 5. *M. Meibomiae*
Mycelial setae crenulate, dentate, or definitely branched.
Capitate hyphopodia opposite ..... 16. *M. serjaniicola*
Capitate hyphopodia alternate.
Setae definitely and dichotomously branched. 14. *M. Tapirirae*
Setae merely dentate or crenulate.
Mycelial branching opposite ..... 4. *M. varicuspis*
Mycelial branching alternate or indefinite.
Internodes long, 20–60 μ ..... 13. *M. Alchorneae*
Internodes much shorter.
Setal tips dentate ..... 6. *M. trinidadensis*
Setal tips crenulate.
Hyphopodial head cells 14–15 μ in diam. ..... 15. *M. tapiriricola*
Hyphopodial head cells 7–10 μ in diam. ..... 17. *M. rhamnicola*

IRENE
(Mycelial setae absent)

Perithecia setose.
Setae straight.
Mycelial branching opposite ..... 27. *I. Ingae*
Mycelial branching alternate ..... 30. *I. sidicola*
Setae spiraled ..... 24. *I. toruloidea*
Setae uncinate ..... 28. *I. Crotonis*
Perithecia glabrous.
Hyphae forming marked angles.
Spores large, 44–54 × 12–17 μ ..... 26. *I. cubitorum*
Spores smaller, 28–37 × 14 μ ..... 25. *I. cubitella*
Hyphae straight or undulate, not angling.
Spores large, up to 50 μ long ..... 23. *I. glabroides*
Spores shorter, up to 40 μ long.
Host a Euphorbiacea ..... 29. *I. Alchorneae*
Host a Marcgraviacea ..... 31. *I. Marcgraviae*

1. **Meliola Aristolochiae** Stevens & Tehon, n. sp.

Colonies small, amphigenous but more often epiphyllous, diffuse, 1–5 mm. in diameter. Mycelium somewhat undulate, 6.5–7 μ in diameter, cells about 32–35 μ long; branching opposite or alternate. Capitate hyphopodia alternate; head cells globose or recurved, 10–12 × 8–12 μ, rarely ovate; basal cells short, 3–3.5 μ long. Mucronate hyphopodia not abundant, bottle-shaped, alternate or opposite, 17–22 μ long. Mycelial setae

straight, black, extremely variable in length, 365–661 μ long, about 8–8.5 μ in diameter; tips obtuse or rarely acute. Perithecial setae none. Perithecia scattered, rough, spherical, 62–132 μ in diameter. Asci 2-spored, soon evanescent. Ascospores brown, obtuse, 4-septate, constricted at the septa, 36–42 × 14–15 μ. (PL. 1, FIG. 1.)

Group No. 3111–3222⅔.

On *Aristolochia* sp.

BRITISH GUIANA: Rockstone, July 17, 1922, No. *459* (type); Kartabo, July 22, No. *453*; July 24, No. *673*; Tumatumari, July 10, Nos. *107*, *108*; July 11, No. *165*.

In Beeli's key this species falls next to *M. panicicola* Syd., from which it is, however, readily distinguished by the character of its capitate hyphopodia and its generally smaller perithecia.

2. **Meliola Coccolobis** Stevens & Tehon, n. sp.

Colonies hypophyllous or rarely epiphyllous, large, irregular, and diffuse. Mycelium crooked, 5–7.5 μ in diameter; branching mostly opposite. Capitate hyphopodia alternate, though rarely opposite; head cells round to ovoid, 7.5 × 7.5–10 μ; basal cells short, 3.5–4 μ long. Mucronate hyphopodia not abundant, alternate or opposite, bottle-shaped, 17 μ long. Mycelial setae straight or curved, black, opaque, 170–300 μ long; tips obtuse and oftentimes irregularly wavy. Perithecial setae none. Perithecia spherical, rough, 140–175 μ in diameter, arising from a pseudoradiate subiculum. Asci evanescent. Ascospores 4-septate, brown, obtuse, constricted at the septa, 33–38 × 10–14.5 μ. (PL. 1, FIG. 2.)

Group No. 3111–3221.

On *Coccolobis* sp.

BRITISH GUIANA: Kartabo, July 24, 1922, No. *655* (type).

TRINIDAD: Cumuto, August 16, No. *903*.

This species is similar to *M. rectangularis* Stev. in having a crooked mycelium; but differs in having mycelial setae and in the mode of branching which is not typically at right angles. In the Beeli key it would fall next to *M. Makilingiana* Syd., with which it could not, however, be confused.

A *Meliola* which appears identical with the above occurs on a species of *Coccolobis* collected at Cumuto, Trinidad, August 16 (No. *903*). It bears no perithecia or spores; the mycelium is slightly coarser; and the mycelial setae are noticeably crooked.

3. **Meliola angusta** Stevens & Tehon, n. sp.

Colonies amphigenous, small or large, not definitely limited, and often diffused. Mycelium straight, 7–7.5 μ in diameter; branching opposite and typically at about a 45° angle. Capitate hyphopodia abundant, opposite, two to every cell; head cells ovoid to conic, 10.5 × 14 μ; basal cells short, 3.5–4 μ long. Mucronate hyphopodia common, opposite or opposite a capitate hyphopodium, ampuliform. Mycelial setae straight, black, 435–850 × 10 μ; tips obtuse. Perithecial setae none. Perithecia scattered, mostly toward the periphery of the colony, rough, 65–185 μ in diameter, seated upon a loose pseudoradiate subiculum. Asci evanescent. Ascospores 4-septate, brown, ends obtuse, constricted at the septa, 14–18 × 37–39 μ. (PL. 1, FIG. 3.)

Group No. 3112–3213.

On *Coccolobis* sp.

BRITISH GUIANA: Kartabo, July 22, 1922, Nos. *558* (type), *514*, *539*; July 23, No. *576*; Rockstone, July 17, Nos. *478*, *487*.

This *Meliola* appears in all its forms only on the type specimen. The several fragments must, however, because of their evident similarity, be considered as belonging to a single species.

The species appears to be one not previously described. In its general aspect it is suggestive of *M. praetervisa* Gail., but differs in its remarkably straight mycelium, the constant angle of its branching, the shape of the capitate hyphopodia, and especially in its spores, which are hardly more than half the size ascribed to Gaillard's species. In the Beeli key it would be placed just before *M. Merremiae* Rehm., from which it is, however, quite distinct.

This and the preceding *Meliola*, so different from each other and from species previously known on their host plant, furnish another opportunity for speculation as to the derivation and relationship of species. *M. Coccolobis* is similar in a general way to *M. rectangularis* which occurs on *Coccolobis* in Porto Rico. The second species is similar to *M. praetervisa*, which also occurs on *Coccolobis* in Porto Rico. The first two have in common crooked mycelium and alternate capitate hyphopodia, the second two straight mycelium and opposite hyphopodia. This arrangement suggests two possibilities: That one of each pair may have been derived from the other; or, that the two pairs represent possible divergent lines of derivation from a common ancestor. The

second possibility seems to be the more plausible, since certain characters, such as the presence of setae and definitely-angled branching, which may be supposed to have been characteristic of the ancestral *Meliola*, have not been definitely segregated among the younger species. Thus setae are present on both South American species but occur only on *M. praetervisa* in Porto Rico, while a definite angle of branching is associated with mycelium and opposite hyphopodia in South America but with a crooked mycelium and alternate hyphopodia in Porto Rico.

4. **Meliola varicuspis** Stevens & Tehon, n. sp.

Colonies amphigenous, large, and diffuse. Mycelium crooked, rather densely netted, 7–7.5 μ in diameter; branching chiefly opposite. Capitate hyphopodia abundant, alternate; head cells variable in shape from cylindrical to lobed, the lobed ones predominating, 14 × 8.5 μ; basal cells usually short, 2.5–3.5 μ long. Mucronate hyphopodia few, often on special branches, irregularly arranged, flask-shaped, 18–21 μ long. Mycelial setae abundant toward the center of the colony, straight, black, opaque, 275–460 μ long; tips frequently entire and obtuse, but more often denticulate with 2 to 4 small, obtuse, divergent teeth rarely more than 3 μ long. Perithecial setae none. Perithecia common, slightly gregarious in the center of the colony, spherical, rough, 125–210 μ in diameter, seated on a pseudoradiate subiculum. Asci evanescent. Ascospores brown, 4-septate, tips obtuse, distinctly constricted at the septa, 41 × 14.5 μ. (PL. 1, FIG. 4.)

Group No. 31 1/3 1–3222.

On an undetermined Annonacea.

COSTA RICA: Aserri, June 26, 1923, No. *132* (type).

As the group number indicates, this species, because of its dentate setae, is readily distinguished from the two species, *M. longipoda* Gail. and *M. Popowiae* Doidge, hitherto described on members of this host family. In the Beeli key it falls next to *M. Imperatae* Syd., with which it has many gross characters in common, but from which it is separated by differences in spore size, setal characters, and mycelial branching.

5. **Meliola Meibomiae** Stevens & Tehon, n. sp.

Colonies amphigenous but more commonly epiphyllous, small, indeterminate, diffuse, and often confluent. Mycelium flexuous

to crooked, 7 μ wide; branching both alternate and opposite. Capitate hyphopodia mostly alternate; the head cells globose, 10 μ in diameter; the basal cells short, 1.5–2 μ long. Mucronate hyphopodia few, bottle-shaped, alternate or opposite the capitate, 14–16 μ long. Mycelial setae common, straight or somewhat flexed, dark but not opaque, multicellular, 196–390 μ long; tips obtuse. Perithecial setae none. Perithecia usually numerous, globose, rough, scattered, 90–135 μ in diameter. Asci evanescent. Ascospores 4-septate, brown, obtuse, 32–37 × 10–14 μ. (PL. 1, FIG. 5.)

Group No. 3111–3222.

On *Meibomia* sp.

BRITISH GUIANA: Rockstone, July 16, 1922, No. *434* (type), July 13, No. *257*; Kartabo, July 24, No. *650*.

This species would fall next to *M. gymnanthicola* Stev. in the Beeli key. It is the first to be described on its host from the Americas, and it is remarkable that while there are already six species and an additional variety known on *Meibomia*, none of them is capable of being confused with our species.

6. **Meliola trinidadensis** Stevens & Tehon, n. sp.

Colonies epiphyllous, small, dense, circular, limited, 0.5–1 mm. in diameter. Mycelium coarse, flexuous, closely interwoven, 8–10 μ wide; branching alternate or opposite. Capitate hyphopodia alternate, often divergent; head cells globose, 10 μ in diameter; basal cells short, 2–2.5 μ long. Mucronate hyphopodia few, ampuliform, 15 μ long. Mycelial setae numerous, long, brown, translucent, multiseptate, not tapering markedly, 300–525 μ long, tips blunt and finely dentate. Perithecial setae absent. Perithecia black, globose, rough, 100–155 μ in diameter. Asci evanescent. Ascospores usually dark brown, 4-septate, clavate, constricted, obtuse, 10–11 × 35–36 μ. (PL. 1, FIG. 6.)

Group No. 3131–3123.

On *Meibomia* sp.

TRINIDAD: St. Augustine, August 13, 1922, No. *825* (type).

In the Beeli key this species falls just before *M. fuscidula* Gail., from which it is entirely distinct. The number of species of *Meliola* reported on members of the genus *Meibomia* is already large—including at least seven forms. Most of these, however, appear reasonably distinct, and our species can not readily be confused with any of them.

7. **Meliola conigera** Stevens & Tehon, n. sp.

Colonies amphigenous, covering about half the surface of the pinnule. Mycelium nearly straight, 7–7.5 μ wide; branching opposite. Capitate hyphopodia abundant, opposite, 2 to each cell, simulating mucronate hyphopodia; head cells conic or flexed-conic, 9–11 μ long; basal cells short, 1.5–2 μ long. Mucronate hyphopodia ampuliform, opposite, 17 μ long. Mycelial setae few, straight, 100–125 μ long. Perithecial setae absent. Perithecia flat and radiate when young, globular and apparently parenchymatous when mature, about 225 μ in diameter, seated upon a heavy pseudoradiate subicle. Asci evanescent. Ascospores 4-septate, brown, constricted at the septa, 28–35 × 9–10 μ. (PL. 1, FIG. 7.)

Group No. 3112–3131.

On *Pentaclethra* sp.

BRITISH GUIANA: Demerara-Essequibo Railroad, July 15, 1922, No. *387a* (type); Wismar, July 14, No. *290*.

On *Pentaclethra macroloba*.

BRITISH GUIANA: Kartabo, July 22, No. *529*.

This species is remarkable in the character of its capitate hyphopodia, which, under the low power of the microscope, appear to simulate mucronate hyphopodia. In this respect it resembles *M. ampulifera* Winter, but is not to be confused with Winter's species, since its hyphopodia have both basal and head cells.

In the Beeli key it falls just before *M. Acalyphae* Rehm., from which it is readily distinguished by perithecial and spore characters.

8. **Meliola Pithecolobii** Stevens & Tehon, n. sp.

Colonies epiphyllous, small, round, dense, 0.5–3 mm. in diameter. Mycelium straight, radially disposed, densely interwoven, rather coarse, 8–8.5 μ in diameter; branching opposite. Capitate hyphopodia alternate, numerous; head cells globose to ovate, 10–12 μ in diameter; basal cells short, not equilateral, 3.5 μ long. Mucronate hyphopodia rare, alternate, ampuliform, 15–17 μ long. Mycelial setae few, much scattered, straight, not translucent, obtuse, 200–250 μ long. Perithecia glabrous, spherical, black, rough, 105–120 μ in diameter, arising from and seated upon a definite pseudoradiate subiculum, apparently ostiolate. Asci evanescent. Ascospores brown, 4-septate, constricted, obtuse, 37–39 × 15 μ. (PL. 1, FIG. 8.)

Group No. 3111–3221.

On *Pithecolobium Jupunba*.

TRINIDAD: Cumuto, August 16, 1922, No. *966* (type).

This species and *M. rizalensis* Syd., near which it falls in the Beeli key, have in common the characteristic of rare setae, but are otherwise distinct.

9. **Meliola byrsonimicola** Stevens & Tehon, n. sp.

Colonies amphigenous but more often hypophyllous, small and round, often confluent and then extensive. Mycelium closely netted, crooked, and often angular, rather coarse, 7–8 μ wide; branching mostly opposite. Capitate hypopodia alternate; head cells variable, globose to ovoid, 14–21 x 12 μ; basal cells 6–7 μ long. Mucronate hyphopodia ampuliform, opposite, 25 μ long. Mycelial setae rare over most of the colony but abundant near the perithecia, large, multi-septate, translucent, 10–12 μ wide and 400–700 μ long; tips obtuse. Perithecial setae none. Perithecia globose, black, rough, 105–180 μ in diameter. Asci 2-spored, evanescent. Ascospores brown, 4-septate, constricted, obtuse, 42–46 $\times$ 17 μ. (PL. 1, FIG. 9.)

Group No. 3111–4233.

On *Byrsonima* sp.

BRITISH GUIANA: Demerara-Essequibo Railroad, July 15, 1922, No. *333* (type), and No. *363*.

This species is, in many respects, similar to *M. Byrsonimae* Stev., but it is distinguishable especially because of its crooked, closely-netted mycelium. The setae appear generally shorter, and are constantly obtusely pointed, and the spores are not so long. In the Beeli key our species falls next to *M. Lucumae* Stev., from which it is however wholly distinct.

This *Meliola* occurs on a different species of the same host genus, with the collection number *1015*, for which no place or date of collection is recorded.

10. **Meliola byrsonimina** Stevens & Tehon, n. sp.

Colonies amphigenous, minute, compact, round. Mycelium straight, dark, much branched, rather coarse, 10 μ in diameter; branching opposite. Capitate hyphopodia abundant, mostly opposite; head cells globose, 14–17 μ in diameter; basal cells variable, usually 5–7 μ long. Mycelial setae few, straight, tapering, 300–350 μ long; tips obtuse. Perithecial setae several,

arising from the base of the perithecium, straight, tapering, black, not translucent, 200–350 μ long; tips obtuse. Perithecia black, spherical, rough, 150–175 μ in diameter. Asci 2-spored, evanescent. Ascospores 4-septate, brown, markedly constricted at the septa, ends obtuse, 35–46 $\times$ 14–17 μ. (PL. 1, FIG. 10.)

Group No. 3412–3232.

On *Byrsonima* sp.

BRITISH GUIANA: Tumatumari, July 10, 1922, No. *106* (type).

This species is entirely distinct in all its characters from the species of *Meliola* already described on its host. It is remarkable because of the density of the hyphopodia, both mucronate and capitate, on the short, straight branches of the mycelium. In the Beeli key it falls next to *M. macrochaeta* Syd. from which it is readily distinguished by its entire, bluntly tipped setae.

11. **Meliola Manihot** Stevens & Tehon, n. sp.

Colonies epiphyllous, minute, round, diffuse. Mycelium straight or slightly flexuous, loosely interwoven, 6–7 μ wide; branching opposite. Capitate hyphopodia mostly alternate, rarely opposite; head cells globose, 7–9 μ in diameter; basal cells short, 2.5–3 μ long. Mucronate hyphopodia frequent, alternate or opposite, or opposite the capitate, ampuliform, 10–12 μ long. Mycelial setae few, well distributed, black, obtuse, 200–250 μ long. Perithecial setae absent. Perithecia black, spherical, rough, 70–90 μ in diameter, usually seated on a close subiculum of light-brown, pseudoradiating, indeterminate hyphae. Asci 2-spored, evanescent. Ascospores light brown, 4-septate, clavate, not greatly constricted, 30–31 $\times$ 14 μ. (PL. 1, FIG. 11.)

Group No. 3111–2211.

On *Manihot palmata*.

BRITISH GUIANA: Tumatumari, July 12, 1922, No. *217* (type).

This species, a very unusual one, falls, in the Beeli key, next to *M. microspora* Pat. & Gail. It is not to be confused with either of the two species hitherto recorded on *Manihot*. The perithecial subiculum and the clavate spores are among its most distinguishing characters.

12. **Meliola Euphorbiae** Stevens & Tehon, n. sp.

Colonies small, round, hypophyllous, heavy, 2–5 mm. in diameter. Mycelium closely interwoven, straight or flexuous, 6.5–7.5 μ in diameter; branching opposite. Capitate hyphopodia

alternate generally though often opposite, numerous; head cells cylindrical, 14–15 μ long; basal cells 2.5–3 μ long. Mucronate hyphopodia rare, alternate, bottle-shaped, 8–12 μ long. Mycelial setae abundant, black, not translucent, straight or falciform, 320–380 μ long; tips obtuse. Perithecial setae absent. Perithecia black, spherical, rough, 60–75 μ in diameter. Asci evanescent. Ascospores brown, 4-septate, constricted at the septa, end cells obtuse, 43 × 17 μ. (PL. 2, FIG. 12.)

Group No. 3111–4212.

On an undetermined Euphorbiacea.

BRITISH GUIANA: Kartabo, July 24, 1922, No. *663* (type).

In the Beeli key this species falls next to *M. micromera* Syd., but is nearer *M. Canarii* Syd. morphologically.

13. **Meliola Alchorneae** Stevens & Tehon, n. sp.

Colonies hypophyllous, round, thin and diffused, small or large. Mycelium loosely interwoven, flexuose, rather fine, 5–6.5 μ wide, cells 45–50 μ long; branching alternate and opposite. Capitate hyphopodia alternate; head cells globose, small, 10 μ in diameter; basal cells 7–10 μ long. Mycelial setae numerous, straight or flexuous, black, not translucent, 340–470 μ long; tips mostly obtuse though often slightly crenulate or very rarely denticulate. Perithecial setae absent. Perithecia spherical, black, rough, 175–180 μ in diameter, seated upon a loose, pseudoradiate subiculum which disappears with age. Asci 2-spored, evanescent. Ascospores brown, 4-septate, constricted at the septa, ends obtuse, 35 × 10 μ. (PL. 2, FIG. 13.)

Group No. 3111–3122.

On *Alchornea* sp.

BRITISH GUIANA: Tumatumari, July 11, 1922, No. *198* (type).

Distinct from any thus far described on Euphorbiaceous hosts, this species, with its graceful, fine mycelium and knob-like capitate hyphopodia, is both striking and unusual. The variation exhibited by the tips of the setae, the majority being straight and blunt but a minority with irregularities ranging from slight crenulations to definite denticulations, furnishes an illustration of the unreliability of certain structures for diagnostic purposes within one species, though the same structures within another species may furnish the most reliable of diagnostic features.

14. **Meliola Tapirirae** Stevens & Tehon, n. sp.

Colonies epiphyllous, thin and diffuse when small, dense and matted when old, glabrous at the periphery, and often densely setose in the center. Mycelium straight or flexuous, rather coarse, 7.5–8.5 μ wide; branching opposite. Capitate hyphopodia alternate; head cells ovoid to oblong, 10–14.5 μ long; basal cells short, 3.5 μ long. Mucronate hyphopodia narrowly ampuliform, alternate, 18 μ long. Mycelial setae usually abundant and often matted in the center of the colony, black, opaque, and dichotomously branched, 200–280 μ long; branches often 30–40 μ long with dichotomously denticulate apices. Perithecial setae absent. Perithecia black, spherical, rough, 115–190 μ in diameter, seated upon a loose pseudoradiate subiculum. Asci evanescent. Ascospores brown, 4-septate, slightly constricted, obtuse, 35–38 × 17–20 μ. (PL. 2, FIG. 14.)

Group No. 3141–3221.

On *Tapirira* sp.

No species of *Meliola* having much-branched setae has yet been reported on any member of the Anacardiaceae. The present species is the first of its kind to be noted on host-members of this family, and is also the first *Meliola* to be recorded on *Tapirira*. In the Beeli key it falls next to *M. Merrillii* Syd.

15. **Meliola tapiriricola** Stevens & Tehon, n. sp.

Colonies epiphyllous, small, round, thin, limited, 2–5 mm. in diameter. Mycelium flexuous, irregular, closely interwoven, 6–7 μ wide; branching alternate. Capitate hyphopodia alternate, numerous; head cells globose, 14–15 μ in diameter; basal cells variable, not often equilateral, 1.5–5 μ long. Mucronate hyphopodia rare, conical to flask-shaped, 15–17 μ long. Mycelial setae numerous, well distributed, rather coarse, semi-translucent, not tapered apically, terminally crenulate for a distance of 30 μ or more, 170–200 μ long. Perithecial setae lacking. Perithecia globose, rough, 142–150 μ in diameter. Asci evanescent. Ascospores brown, 4-septate, obtuse, constricted, 32–35 × 10–12 μ. (PL. 2, FIG. 15.)

Group No. 3131–3221.

On *Tapirira guianensis*.

BRITISH GUIANA: Wismar, July 14, 1922, No. *283* (type).

This species, whose outstanding characteristic is the crenulate setal tips, falls next to *M. crenatissima* Syd. in the Beeli key. It is very similar in many respects to Sydow's species, but its crenu-

lations when compared with those figured by Sydow are much more marked and really deserve the superlative in description.

16. **Meliola serjaniicola** Stevens & Tehon, n. sp.

Colonies hypophyllous, small, round, diffuse, 0.5–3 mm. in diameter. Mycelium densely interwoven, straight, radially arranged, coarse, 10 μ in diameter; branching opposite. Capitate hyphopodia opposite, two to every cell; head cells globose, 14 μ in diameter; basal cells short and nearly equilateral, 1.5–2 μ long. Mucronate hyphopodia very rare, bottle-shaped, 20–22 μ long. Mycelial setae abundant, coarse, black, not tapering, apically divided into two to many teeth, 230 μ or more long. Perithecial setae absent. Perithecia spherical, black, rough, 140–150 μ in diameter. Asci evanescent. Ascospores brown, 4-septate, constricted, the middle cell of greater diameter than the others, ends obtuse, 37–40 $\times$ 17–18 μ. (PL. 2, FIG. 16.)

Group No. 3132–3222.

On *Serjania paucidentata*.

BRITISH GUIANA: Coverden, August 8, 1922, No. *798* (type).

This species, which falls next to *M. fuscidula* Gail. in the Beeli key, can not readily be confused with any of the species hitherto recorded on Sapindaceous hosts.

17. **Meliola rhamnicola** Stevens & Tehon, n. sp.

Colonies hypophyllous, thin, diffuse, and not limited, 1.5 cm. or more in diameter. Mycelium small and delicate, wavy, and closely interwoven, 4.5–6 μ wide; branching opposite. Capitate hyphopodia alternate, often arranged along one side of the hypha for some distance, extending outward at a wide angle; head cells globose, 7–10 μ in diameter; basal cells short but distinct and nearly equilateral, 3.5–4.5 μ long. Mucronate hyphopodia not abundant, alternate, bottle-shaped, 12 μ long. Mycelial setae straight or flexuous, black, not translucent, tips obtuse or variously formed from crenulate to dentate, 325–375 μ long. Perithecial setae none. Perithecia globose, black, rough, 150–175 μ in diameter, seated on a loose, pseudoradiate subiculum. Asci 2-spored, evanescent. Ascospores brown, 4-septate, very slightly constricted, 12–14 $\times$ 25–28 μ. (PL. 2, FIG. 17.)

Group No. 31 $\frac{1}{3}$ 1–2222.

On *Gouania* sp. (?).

BRITISH GUIANA: Tumatumari, July 11, 1922, No. *203* (type).

This species, the second to be described on a Rhamnacea, falls

after *M. anceps* Syd., in the Beeli key; but its delicate and graceful hyphae and its strikingly shaped, prominent, and spreading hyphopodia characterize it definitely as a separate species.

18. **Meliola olecranonis** Stevens & Tehon, n. sp.

Colonies hypophyllous, circular, limited, 5–10 mm. in diameter, dense. Mycelium densely interwoven, extremely crooked, 6–7 μ wide, the hyphal strands often forming elbows. Capitate hyphopodia alternate; head cells obovate to subspherical, 10–12 μ long; basal cells short, 3–4 μ long. Mucronate hyphopodia not seen. Mycelial setae abundant, black, opaque, straight, 320–350 μ long; tips entire and tapering but not acute. Perithecial setae absent. Perithecia spherical, black, rough, 125–140 μ in diameter. Asci 2-spored, evanescent. Ascospores brown, 4-septate, constricted, apical cells both acute, usually one more so than the other, 40 × 11 μ. (PL. 2, FIG. 18.)

Group No. 3111–3222.

On *Guajava* sp.

BRITISH GUIANA: Tumatumari, July 8, 1922, No. *64* (type).

This *Meliola*, which is closely similar in mycelial characters to the species *Irene cubitella* and *I. cubitorum* described later in this paper, is remarkable for the abundance of its gracefully tapered setae and the peculiar and distinctive angulation exhibited at the mycelial nodes. The name of the species has been selected because of the projection frequently found at the angles, which is suggestive of an elbow. In the Beeli key, it falls next to *M. velutina* Wint.

19. **Meliola Lisianthi** Stevens & Tehon, n. sp.

Colonies epiphyllous, dense, round, limited, 1–10 mm. in diameter. Mycelium straight or flexuous, loosely interwoven, 6.5–7.5 μ wide; branching mostly opposite. Capitate hyphopodia numerous, alternate; head cells globose, 7–9 μ in diameter; basal cells short, 1.5–3 μ long, not equilateral. Mucronate hyphopodia not abundant, opposite, ampuliform, 12–15 μ long. Perithecia glabrous, often very rough, spherical, pseudo-ostiolate, 107–115 μ in diameter. Asci 2-spored, evanescent. Ascospores brown, 4-septate, deeply constricted, slightly clavate, obtuse, 8.5 × 22 μ. (PL. 2, FIG. 19.)

Group No. 3111–2121.

On *Lisianthus grandiflorus*.

BRITISH GUIANA: Wismar, July 14, 1922, No. *316* (type).

This appears to be the first *Meliola* recorded on a Gentianacea. In the Beeli key it falls just before *M. paraensis* Henn., and is made unique in its group by the small spores which are both unusually short and unusually narrow.

20. **Meliola gnathonella** Stevens & Tehon, n. sp.

Colonies epiphyllous, minute, rarely more than 0.5 mm. in diameter, associated with a definite diseased spot on the host leaf. Mycelium flexuous, rather crowded, 6.5–7 μ wide; branching opposite. Capitate hyphopodia alternate, 15–17 μ long; head cells globose, 12–15 μ in diameter; basal cells 2–3 μ long. Mucronate hyphopodia bottle-shaped, alternate, 15–18 μ long. Mycelial setae arising near the perithecia, black, straight or flexuous, 200–250 μ long; tips obtuse. Perithecial setae absent. Perithecia globose, gregarious or even crowded in the center of the colony, rough, 130–160 μ in diameter. Asci evanescent. Ascospores 4-septate, brown, constricted at the septa, obtuse, slightly clavate, 33–39 $\times$ 14 μ. (PL. 2, FIG. 20.)

Group No. 3111–3221.

On *Jacaranda* sp. (?).

BRITISH GUIANA: Tumatumari, July 12, 1922, No. *231* (type).

The only instance, among the species recorded here, of a *Meliola* causing a definitely diseased spot upon the host leaf occurs in connection with this species.

21. **Meliola amphigena** Stevens & Tehon, n. sp.

Colonies amphigenous, small, thin, diffuse, and irregular, 0.5–3 mm. in diameter. Mycelium very dark, straight or flexuous, 6–6.5 μ wide; branching alternate. Capitate hyphopodia alternate; head cells globose to ovate, 7–8.5 μ in diameter, rather closely appressed to the mycelial strands by the very short basal cells which are not equilateral. Mucronate hyphopodia rarely present. Mycelial setae few, scattered, black, opaque, straight, tapering, 275 μ long; tips obtuse. Perithecial setae lacking. Perithecia abundant, scattered, black, spherical, smooth, arising by pseudoradiate cell proliferation from capitate hyphopodia, 90–110 μ in diameter. Asci 2-spored, evanescent. Ascospores brown, 4-septate, constricted, clavate, 28–29 $\times$ 10 μ; end cells obtuse. (PL. 2, FIG. 21.)

Group No. 3111–2111.

On an undetermined Rubiacea.

BRITISH GUIANA: Tumatumari, July 11, 1922, No. *168* (type); Rockstone, July 17, 1922, No. *450*; Demerara-Essequibo Railroad, July 15, 1922, No. *413*.

In the Beeli key this species falls just before *M. microspora* Pat. and Gail., and forms the first species of the group, among the members of which it is unique because of the smallness of its perithecia. It is apparently closely related to *M. Psychotriae* Earle.

22. **Meliola Malaneae** Stevens & Tehon, n. sp.

Colonies hypophyllous, large, loose, thin, diffuse, not limited, irregular in outline. Mycelium loosely interwoven, flexuous, 7–7.5 μ wide; branching opposite. Capitate hyphopodia alternate, separating cells of the mycelium 30–40 μ long; head cells ovoid to oblong, 14–17 $\times$ 10 μ; basal cells variable from short to rather long, usually narrower than the mycelium, not equilateral, 4–10 μ long by 4.5–6 μ wide. Mucronate hyphopodia numerous, ampuliform, with unusually long necks, mostly opposite, up to 25 μ long. Mycelial setae few, scattered, black, not translucent, straight, 700–1100 μ long, often grouped near the perithecia; tips obtuse. Perithecial setae absent. Perithecia black, spherical, rough, 115–140 μ in diameter, originating from capitate hyphopodia by pseudoradiate cell proliferation, at maturity seated upon a loose subiculum of radiating, indeterminate, light-colored hyphae which often bear hyphopodia. Asci 2-spored, evanescent. Ascospores brown, 4-septate, rather deeply constricted, terminal cells obtuse, central cells often expanded much beyond the others, 46–53 $\times$ 16–17 μ. (PL. 2, FIG. 22.)

Group No. 3111–4223.

On *Malanea* sp.

TRINIDAD: Cumuto, August 16, 1922, No. *911* (type).

On *Malanea macrophylla*.

TRINIDAD: Cumuto, August 16, No. *949*.

On *Psychotria* sp.

TRINIDAD: Cumuto, August 16, No. *944*.

This interesting species, which falls just after *M. Roureae* Syd. in the Beeli key, is distinguished from *M. longipoda* Höhnel, which is recorded on at least one Rubiacea and has the same group number, by the presence of mucronate hyphopodia, the shorter setae, and its smaller perithecia.

The specimen on *Psychotria*, which is evidently of the same

species and not sufficiently distinct to be recorded as a variety, has spores which measure 53 × 21–22 μ—a difference which modifies the diagnostic number of the species to read 3111–5323 for the form of *Psychotria*.

23. IRENE GLABROIDES (Stevens) Toro, Mycologia **17**: 142. 1925.

Meliola glabroides Stevens, Ill. Biol. Monog. **2**: 18. 1916.

On members of the Annonaceae, genera and species not determined.

BRITISH GUIANA: Kartabo, July 22, 1922, Nos. *569*, *572*; July 24, No. *669*; Demerara-Essequibo Railroad, July 15, No. *379a*; Rockstone, July 16, No. *421*.

On *Nectandra* sp.

BRITISH GUIANA: Wismar, July 14, Nos. *285*, *311*, *315*, *321*.

On *Simaba* sp.

BRITISH GUIANA: Wismar, July 14, No. *309*.

On *Icica* sp.

TRINIDAD: Cumuto, August 16, No. *936*.

On *Sauvagesia erecta*.

BRITISH GUIANA: Rockstone, July 16, No. *432*.

On *Vismia latifolia*.

BRITISH GUIANA: Wismar, July 14, No. *299*.

24. **Irene toruloidea** (Stevens) Stevens & Tehon, n. comb.

Meliola toruloidea Stevens. Ill. Biol. Monog. **2**: 25. 1916.

On *Cassia* sp.

TRINIDAD: Cumuto, August 16, 1922, No. *937*.

The agreement between this specimen and the type from Porto Rico is remarkable as to the size of the colony, perithecia, mycelium and spores, as well as the characteristic perithecial setae.

25. **Irene cubitella** Stevens & Tehon, n. sp.

Colonies hypophyllous, 1–10 mm. in diameter or more. Mycelium crooked and often angular, 6.5–7 μ wide; branching alternate. Capitate hyphopodia alternate, 14–17 μ long; head cells globose, 14 μ in diameter; basal cells 1–3 μ long. Mucronate hyphopodia alternate or opposite, bottle-shaped, 14–18 μ long. Setae none. Perithecia spherical, rough, 56–82 μ in diameter. Spores 4-septate, brown, obtuse, constricted, 28–37 × 14 μ. (PL. 2, FIG. 23.)

Group No. 3101–3210.

On *Cassia* sp.

BRITISH GUIANA: Tumatumari, July 11, 1922, Nos. *119* (type), *193*.

TRINIDAD: Cumuto, August 16, No. *941*.

This species, which falls next to *M. Sandorici* Rehm. in the Beeli key, is suggestive in its general aspect of *I. cubitorum*, which is also described in this paper as occurring on a leguminous host, but is smaller and not to be confused with it.

26. **Irene cubitorum** Stevens & Tehon, n. sp.

Colonies hypophyllous, usually circular, 0.5 cm. in diameter or more. Mycelium very crooked, making a well-defined angle at each cell juncture, the diameter usually increased at the cell unions, and the wall extended outward to form a pointed projection; hyphae 7–9.5 μ wide; branching both alternate and opposite. Capitate hyphopodia alternate; head cells irregularly angular, about 14 μ long; basal cells variable in length, from 3 to 10 μ or more long. Mucronate hyphopodia alternate, irregular, but mostly bottle-shaped, about 20 μ long. Setae none. Perithecia flat when young, globular when mature, rough, 107–152 μ in diameter. Asci 2-spored, evanescent. Ascospores brown, obtuse, constricted at the septa, 4-septate, 44–54 $\times$ 12–17 μ. (PL. 2, FIG. 24.)

Group No. 3101–5220.

On *Dimorphandra latifolia*.

BRITISH GUIANA: Coverden, August 8, 1922, No. *810* (type); Demerara-Essequibo Railroad, July 15, No. *417*.

On *Dimorphandra* sp.

BRITISH GUIANA: Demerara-Essequibo Railroad, July 15, No. *380*.

A startlingly unique appearance is possessed by this species when viewed under the low power of the microscope, for the close intermingling of the hyphae, together with the characteristic angling, reminds one of a wire netting. The species is not similar to any hitherto described on a leguminous host; though it is closely resembled by the smaller, more delicate *Irene cubitella*, described in this paper. In Beeli's key it comes just before *M. calva* Speg., with which, however, it could not possibly be confused.

27. **Irene Ingae** Stevens & Tehon, n. sp.

Colonies hypophyllous, extensive, thin, diffuse. Mycelium delicate, wavy, closely interwoven, 4–4.5 μ wide; branching opposite. Capitate hyphopodia alternate or opposite, or indifferently arranged, widely divergent; head cells globose to ovoid, 10–14 μ in diameter; basal cells 7 μ long. Mucronate hyphopodia alternate, rarely opposite, bottle-shaped, 21 μ long. Mycelial setae lacking. Perithecial setae 3 to 7 in number, attached to the lower half of the perithecium, flexuous but not toruloid, indeterminate though slightly enlarged apically, 100–120 μ long. Perithecia globose, black, rough, 100–115 μ in diameter; hyphae of the perithecial subiculum few, long, divergent and hyphopodiate. Asci 2-spored, evanescent. Ascospores dark brown, 4-septate, slightly constricted, the central cell much larger than the others and spherical, end cells obtuse, 14–16 × 32–39 μ. (PL. 2, FIG. 25.)

Group No. 3401–3220.

On *Inga* sp.

BRITISH GUIANA: Kartabo, July 22, 1922, No. *559* (type).

A first view of the perithecia of this species is suggestive of *M. toruloidea* Stev., which has been reported on a species of the same host genus from Porto Rico. The large size and diffuse nature of the colony, however, is strikingly different, as are also the relatively indifferent arrangement of the capitate hyphopodia and the characters of the perithecial setae. In the Beeli key this species falls next to *M. bayamonensis* Tehon.

28. **Irene Crotonis** Stevens & Tehon, n. sp.

Colonies amphigenous, thin, and minute, discernible upon the leaf only as dark flecks. Mycelium loosely interwoven, slightly flexuous, diverging rather symmetrically, 7–7.5 μ wide; branching opposite. Capitate hyphopodia alternate, abundant; the head cells globose, 10–11 μ in diameter; the basal cells short, not equilateral, 3.5–4 μ long. Mucronate hyphopodia bottle-shaped, opposite or rarely alternate, often segregated on special lateral branches, 14–15 μ long. Mycelial setae none. Perithecial setae subapical, 3 to 5 in number, translucent, apex markedly hooked but not coiled, 90 μ long or less. Perithecia rough, globular, black, 85–100 μ in diameter, seated upon a very loose pseudoradiate subiculum, apparently ostiolate. Asci evanescent. Ascospores brown, oblong, 4-septate, obtuse, 32–35 × 12–14 μ. (PL. 2, FIG. 26.)

Group No. 3301–3210.

On *Croton* sp.

TRINIDAD: St. Augustine, August 13, 1922, No. *837* (type).

In the Beeli key this species falls just before *M. toruloidea* Stev. to which it is very similar though readily distinguishable by its noticeably hooked perithecial setae and very characteristic tendency to segregate the mucronate hyphopodia on lateral hyphal branches.

29. **Irene Alchorneae** Stevens & Tehon, n. sp.

Colonies epiphyllous, small, round, diffuse. Mycelium straight or slightly flexuous, 7 μ wide; branching opposite. Capitate hyphopodia alternate; head cells strikingly globose, rarely ovoid, 17–19 μ in diameter; basal cells short, 1.5–2 μ long. Mucronate hyphopodia rare, opposite, bottle-shaped, 14–17 μ long. Setae none. Perithecia small, globose, nearly smooth, 70 μ in diameter, seated on a loose, pseudoradiate subiculum. Asci evanescent. Ascospores brown, 4-septate, obtuse, 35–40 × 14–17 μ. (PL. 2, FIG. 27.)

Group No. 3101–2210.

On *Alchornea cordata*.

BRITISH GUIANA: Tumatumari, July 12, 1922, No. *245* (type), July 10, No. *153a*.

In the Beeli key this species falls between *M. confragosa* Syd. and *M. usteriana* Rehm. It appears to be quite distinct from any of the species thus far described on members of the Euphorbiaceae.

30. **Irene sidicola** Stevens & Tehon, n. sp.

Colonies hypophyllous, small, round, diffuse, 1–3 mm. in diameter. Mycelium crooked, loosely interwoven, 6–7.5 μ wide; branching alternate. Capitate hyphopodia alternate, irregularly distributed; head cells globose to ovoid and occasionally angled, 7–10 μ in diameter; basal cells variable, 2–7 μ long. Mucronate hyphopodia mostly opposite, ampuliform, 15 μ long. Mycelial setae absent. Perithecial setae few, usually but one on a perithecium, straight, obtuse, 40–55 μ long. Perithecia spherical, rough, black, 150–160 μ in diameter. Asci evanescent. Ascospores brown, 4-septate, obtuse, 32 × 12 μ. (PL. 2, FIG. 28.)

Group No. 3401–3220.

On *Sida* sp.

BRITISH GUIANA: Rockstone, July 17, 1922, No. *478* (type).

This species, which is entirely distinct from the three species thus far recorded on *Sida*, falls next to *M. aciculosa* Wint. in the Beeli key. It is particularly remarkable because of the frequent occurrence of a single seta on the perithecia, which are otherwise quite glabrous.

31. **Irene Marcgraviae** (Tehon) Stevens & Tehon, n. comb.

Meliola Marcgraviae Tehon, Bot. Gaz. **67**: 506. 1919.

On *Marcgravia* sp.

BRITISH GUIANA: Tumatumari, July 10, 1922, No. *110*.

EXPLANATION OF PLATES 1 AND 2

Figs. 1–22. *Meliola* spp. (*a*, mycelium; *b*, setae; *c*, spores)

1. *M. Aristolochiae;* 2. *M. Coccolobis;* 3. *M. angusta;* 4. *M. varicuspis;* 5. *M. Meibomiae, d*, perithecium; 6. *M. conigera;* 7. *M. trinidadensis, d*, dividing hyphopodium; 8. *M. Pithecolobii, d*, subiculum; 9. *M. byrsonimicola;* 10. *M. byrsonimina;* 11. *M. Manihot;* 12. *M. Euphorbiae;* 13. *M. Alchorneae;* 14. *M. Tapirirae;* 15. *M. tapiriricola, d*, subiculum; 16. *M. serjaniicola;* 17. *M. rhamnicola;* 18. *M. olecranonis, d*, perithecium; 19. *M. Lisianthi, d*, perithecium; 20. *M. gnathonella;* 21. *M. amphigena;* 22. *M. Malaneae.*

Figs. 23–28. *Irene* spp. (*a*, mycelium; *b*, spores; *c*, perithecium)

23. *I. cubitella;* 24. *I. cubitorum;* 25. *I. Ingae;* 26. *I. Crotonis;* 27. *I. Alchorneae;* 28. *I. sidicola.*

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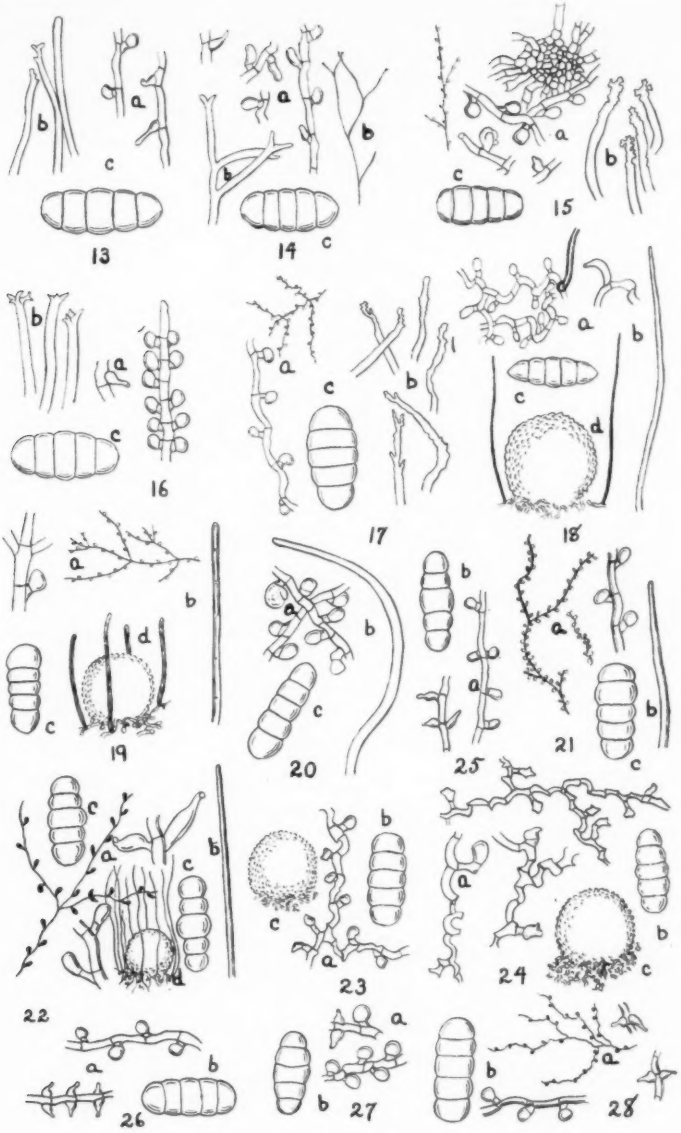


MELIOLA AND IRENE

THE NUMBER AND ARRANGEMENT OF FLAGELLA OF THE FIRE BLIGHT PATHOGEN, BACILLUS AMYLOVORUS

H. R. Rosen

(With Plates 3 and 4)

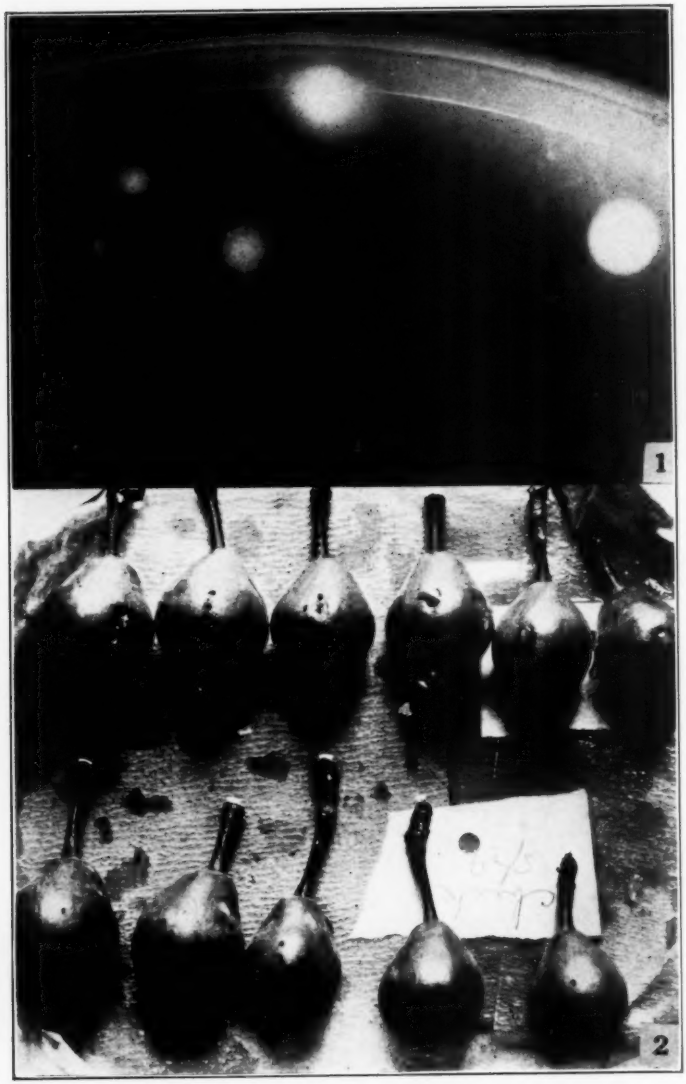
In the early part of the summer of 1924 and again in 1925, the writer isolated bacteria from apples which had shown typical symptoms of fire blight. Not only the fruit but the spurs, twigs, and leaves all indicated this disease. The isolations, beginning with a series of 10 poured plates, resulted in apparently pure cultures of *Bacillus amylovorus*. Growth on nutrient agar, broth, milk, and other media all compared with written descriptions of this organism (Pl. 3, fig. 1). However, when transfers of these were subjected to a flagella stain, developed by the writer, the organisms instead of showing numerous peritrichiate flagella showed only single, polar flagella. As the fire blight organism has been known for many years and apparently has been well worked out, the writer, not having any green apples or pears available at the time of the first isolation (this was in July, 1924), assumed that the isolated organism was not *B. amylovorus*.

To my surprise, the organism isolated the second time, May, 1925, while otherwise showing characteristics of *B. amylovorus* like the 1924 isolation, also showed rods with only single, polar flagella. Infection experiments were immediately undertaken. Six green pears were inoculated by means of needle punctures, the needle carrying a pure culture, while five others, wounded in a similar fashion but not inoculated, served as checks. All were then placed in a moist chamber. Within 48 hours typical, blackish spots appeared in all the inoculated fruit, around the needle punctures, while all the checks remained sound. In a few days the rotted areas showed creamy-white droplets exactly comparable to the bacterial ooze of blighted fruit resulting from natural infection. All the checks remained healthy (Pl. 3, fig. 2). From one of the inoculated pears, the organism was

recovered by ordinary surface sterilization, dilution method, and used for another series of inoculations upon green pears, using an adequate number of fruits as checks. Again, all inoculated fruit became infected, while checks remained healthy (PL. 4, FIG. 1). Five succulent, pear water-sprouts were then inoculated by means of hypodermic injections, while 5 others were comparably wounded by a sterile, hypodermic needle but not inoculated. The cut ends of the twigs were placed in battery jars containing water, and the whole then covered with bell jars. After several days the inoculated twigs showed a severe blighting at the tips while the wounded checks, though showing from 1 to 3 blackened leaves, did not develop any comparable blight. (Presumably the wounding was responsible for the damage in the checks.) The evidence thus appears substantial that the true fire blight germ was involved.

Now, numerous investigators, including Dr. Erwin F. Smith, have reported the causal organism of fire blight as a peritrichiate rod. Indeed, the generic name, *Bacillus*, has been applied to it primarily because it was supposed to possess a number of flagella arranged around the rod. Smith (Bacterial Diseases of Plants, fig. 291, p. 377) presents a microphotograph showing the organism, presumably with several peritrichiate flagella (PL. 4, FIG. 3). As the various preparations which I have made for the two different isolations and for the one reisolation all show rods with but single, polar flagella (PL. 4, FIG. 3), one wonders what the explanation for this discrepancy may be. There are at least three possible explanations for this. First, that different species are involved and that either the one here considered, or the one considered by other investigators, is not representative of the true pathogen. Second, that there exist different strains of the same species, varying in the number and arrangement of flagella. Third, that difference in flagella staining methods may account for the apparent discrepancy.

I am inclined to favor the third, and for this reason. In most of the preparations made by the older flagella staining methods, such as van Ermengem's or Loeffer's, the bodies are considerably distorted and out of proportion, and there is apt to appear a more or less heavy precipitate on and around the organisms. These



BACILLUS AMYLOVORUS

features often make it impossible to tell whether a given figure represents one rod or a group of rods. Dr. Smith's photograph, noted above, I believe is open to this criticism. While the flagella are heavily stained and well reproduced, the shape, size, and outlines of the bodies are quite indefinite.

In view of the long established name of the causal organism of fire blight, I am reluctant to offer any change in the name, at least not until other investigators have had an opportunity of re-examining *B. amylovorus* and reporting their results.[1] In the meantime, it may be well to bear in mind that the generic name, *Bacillus*, will not be tenable should it be confirmed that the organism has only a single polar flagellum. If Migula's nomenclature is followed, the name *Pseudomonas amylovorus* will be applied, or if Dr. Smith's system is followed, *Bacterium amylovorus* will be proper. The recent suggestions of name changing sponsored by the Society of American Bacteriologists (Bergey's Manual of Determinative Bacteriology, 1923) have not as yet met with favor among plant pathologists. A committee representing the bacteriologists has taken up the generic name *Erwinia*, first proposed by them in 1917, in which they place all plant pathogens possessing peritrichiate flagella. Unfortunately they have chosen for the type species *Bacillus amylovorus*, giving it the name *Erwinia amylovora*. If my findings are correct, then it will have to be placed in their new genus *Phytomonas*.[2]

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EXPLANATION OF PLATES

PLATE 3

Fig. 1. Colonies on nutrient agar, poured plates, several days old. Note the irregular, fuzzy margin of the buried colonies. (See Smith's Bacterial Diseases of Plants, pp. 369–370.) Slightly enlarged.

Fig. 2. Top row—6 pears inoculated by means of needle pricks with *B. amylovorus*. Photographed 4 days after inoculation. Note the bacterial ooze appearing in several of the inoculation centers.

Bottom row—checks, wounded but not inoculated.

[1] The flagella staining method developed by the writer will shortly be ready for publication.

[2] What a pity that some agreement cannot be had among plant pathologists and bacteriologists on the use of generic names!

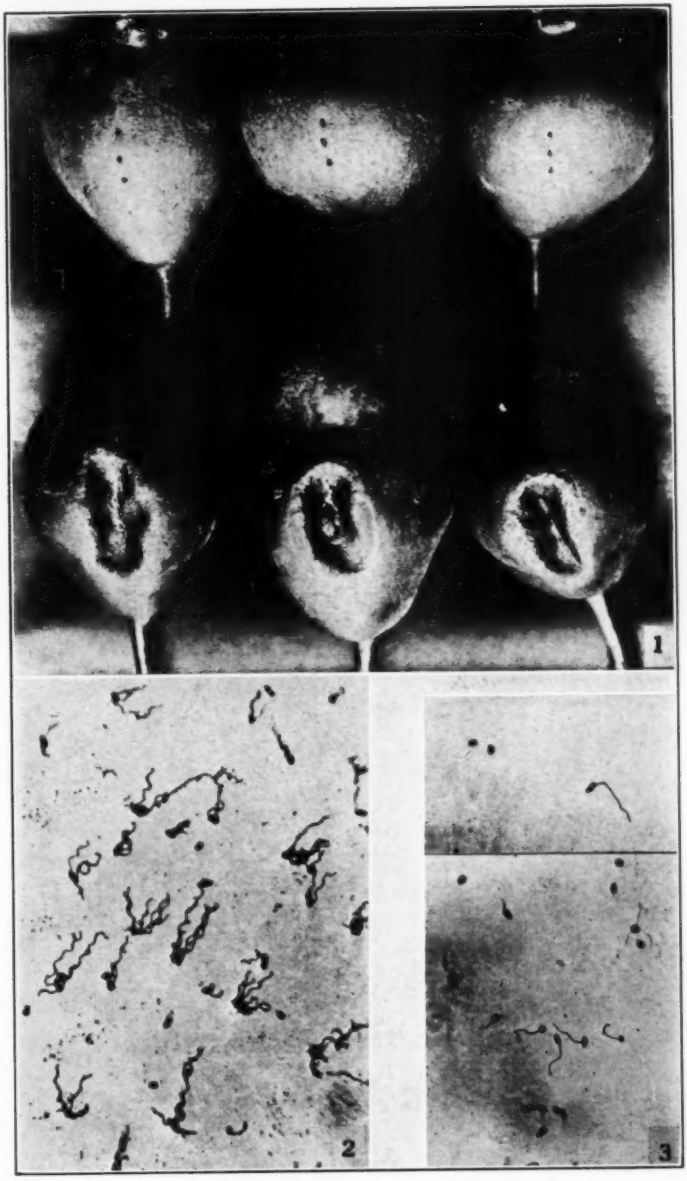
PLATE 4

Fig. 1. Bottom row—inoculated with a reisolation from one of the infected pears shown in pl. 3, fig. 2. Absence of ooze and the depression of the pears in the infected regions is due to drying out of chambers.

Top row—checks.

Fig. 2. *Bacillus amylovorus* after Erwin F. Smith (Bacterial Diseases of Plants, fig. 291, p. 377). Note the variation in size and in outline of the bodies of the bacteria. Magnified about 1000 times.

Fig. 3. *B. amylovorus* stained by a method developed by the writer. Magnified about 1000 times. Wherever more than one flagellum appeared, careful examination always revealed more than one organism.



BACILLUS AMYLOVORUS

POLYPORUS ANCEPS AND POLYPORUS IMMITIS *

C. H. KAUFFMAN

(WITH PLATE 5)

Among the white polypores named by Peck, the two species *P. anceps* Peck and *P. immitis* Peck are probably the least known, partly because of their rarity, partly because they have been thrown into synonymy by recent students of the Polyporaceae. It was natural to look for *P. anceps* on hemlock, the wood on which it was collected by Dr. Burt and given as the host in Peck's account. Occasionally I have run across a white *Polyporus* growing on coniferous wood, a plant which clearly did not belong to any of the white species now fairly well known as growing on conifers. Until within the last half dozen years I had no suspicion that these might belong to *Polyporus anceps*. After the idea had suggested itself, however, I studied collections more carefully and am strongly inclined to think that my plants belong to that species. Recently I obtained photographs from two such collections, one collected near Ann Arbor, Michigan, on tamarack, the other from Elkmont, Tennessee, on pine. There is no "a priori" reason that I can see, why this species should be limited to hemlock.

Weir (**6**) has referred a western plant growing on *Larix* and on *Pinus* to Dr. Peck's species. This western polypore is white, but tends to become reddish or sordid stained in age, and as Lloyd (**1**) well remarks, Peck's plants are white and remain white or whitish. Through the kindness of the Office of Forest Pathology at Washington, D. C., I was able to examine some of these western collections. The specimens, however, to which I have assigned the name of *P. anceps* were white when fresh, or showed only slight traces of yellowish where bruised either on the edge of the pileus or on the pore mouths. They dry white

* Papers from the Department of Botany of the University of Michigan, No. 237.

"in situ," or remain white in the herbarium. I append the following description drawn from the Michigan and Tennessee collections:

Resupinate-reflexed, usually vertically extended lengthwise of trunks or stumps, resupinate between the reflexed pilei, or pilei connate behind or subimbricate; pilei narrowly dimidiate, 3–7 cm. wide, 1–3 cm. long, *i.e.*, laterally elongated or subconfluent, milk-white to dull white, unchanging; surface minutely downy, glabrescent, uneven with small tubercles or rugosely pitted or slightly scrupose, sometimes concentrically subsulcate near the margin; margin obtuse, rather abrupt, slightly lutescent where bruised when fresh; context *subcoriaceous*, *Trametes*-like, but pulling off from tube-layer, white or whitish, relatively thin, 1–5 mm. radially tough-fibrous; tubes 4–8 (10) mm. long when well developed, white, decurrent, reaching the abrupt margin of the pileus; pores small, 3 per millimeter, circular, dissepiments obtuse, occasionally slightly yellowish stained where bruised; spores hyaline, oblong, 7–8 (9) × 3–3.5 μ: basidia 4-spored; cystidia none. (PLATE 5.)

When well developed, the fruit body covers much more of the vertical surface of the substratum than did the specimens from which Peck drew his description (**4**); such plants are hardly comparable to the traditional concept which is usually held of *P. semisupinus* and *P. semipileatus*, with which Peck compares his plant. It is reasonable to suppose that the species was described from specimens which were not very fully developed. This is probably the reason that Peck gave no spores characters with his account.

Polyporus immitis (see Peck, **5**) has been reduced to synonymy under *P. galactinus* Berk. both by Murrill (**2**) and by Overholts (**3**). This is not surprising, because the two plants frequently are extremely alike in most of their characters. There are, however, some fundamental differences. I have studied with great care a number of fresh and thoroughly typical collections of *P. galactinus* during the past years, and the spores of this species when in good condition and abundant are subglobose to oval, measuring on an average 4 × 3 μ, or if one follows the ordinary usage, the variation is best expressed by the size 3–4.5 × 2.7–3.5 μ.

Immature spores, often abundant in a mount, will of course, if included, disturb the above measurement; only fresh, mature and therefore turgid spores should be taken into account. In contrast to this, the spores of *P. immitis*, as I know it, are truly oblong, narrow, and measure 3.5–5 × 1.5–1.8 μ, rarely 2 μ thick; both have 4-spored basidia.

The other main distinction between these two species is in the character of the context. In *P. galactinus* the context is duplex, and the species falls naturally in the *Spongipellis* group as given in the North American Flora. However, the thickness of the upper layer is externally variable, and fresh plants may show this layer quite prominently with a thickness of 2 to 3 mm., while others show only a thin tomentose surface scarcely recognizable as a layer. In *P. immitis* there is no upper horizontally differentiated layer, the tuberculose surface being due to small extensions of bundles of fibres growing radially to the surface. The odor of *P. immitis* is aromatic, or may be called a sweet acid odor; but there is no distinction here that could be used to distinguish it from *P. galactinus*, which has a very similar odor. Both are really fragrant when collected in good growing condition.

In practically all other characters the two species are very similar; in size, habit, color, length of tubes and pore size the two are indistinguishable. In the dried condition also, there is great similarity. My studies of *P. immitis* were made from two collections; one from Quincy, Michigan, on an ash log, the other from Seventh Lake, Adirondack Mountains, New York, on a yellow birch log. The latter plants attracted my attention by general features only; they had much the appearance of *P. galactinus* which was rather frequent in that region, and until I examined the spores I thought it simply a case of variability of the latter species. The fact that Peck reported it only on *Fraxinus* doubtless has had its share in the neglect which the species has received. Professor Athinson, however, collected it both at Ithaca and in the Adirondacks.

In conclusion, I wish to point out that the zonation of the context in *P. galactinus* is more variable than is usually supposed. Fresh plants may show scarcely any zonation, but on losing moisture or after being dried, the zoned condition becomes quite

marked. In *P. immitis* zonation was very inconspicuous in the fresh plants.

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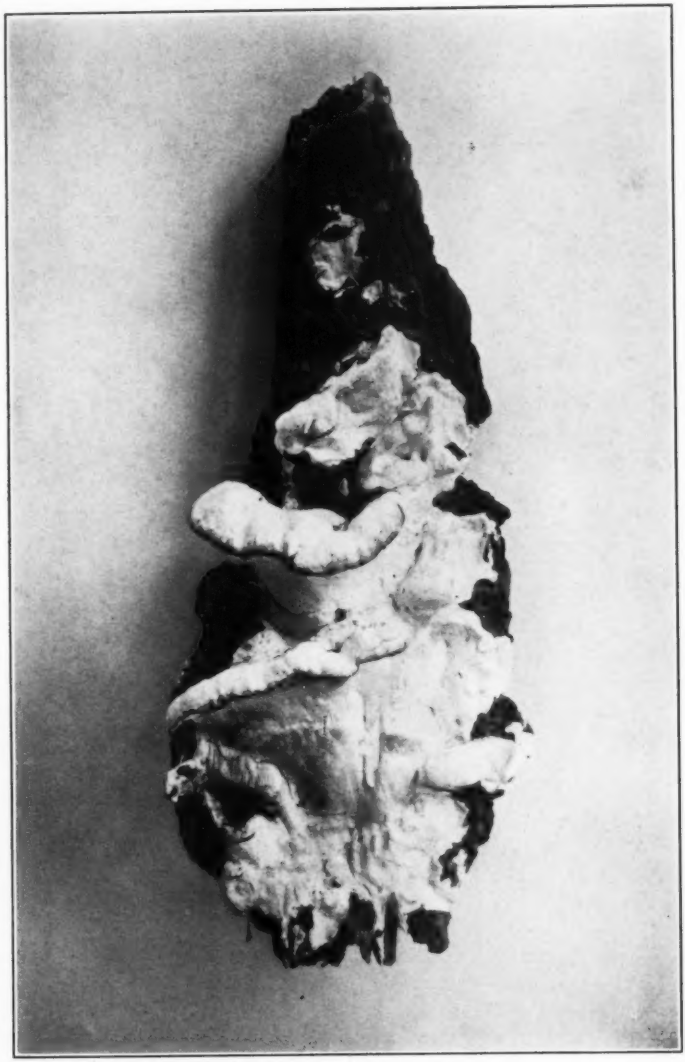
LITERATURE CITED

1. **Lloyd, C. G.** Myc. Notes **5**: 655. 1917.
2. **Murrill, W. A.** Polyporaceae. N. Am. Fl. **9**: 39. 1907.
3. **Overholts, L. O.** The Polyporaceae of the middle-western United States. Wash. Univ. Studies **3**: 52. 1915.
4. **Peck, C. H.** New species of fungi. Bull. Torrey Club **22**: 207. 1895.
5. **Peck, C. H.** Ann. Rep. N. Y. State Mus. **35**: 135. 1884.
6. **Weir, J. R.** Montana forest tree fungi. Mycologia **9**: 132. 1917.



POLYPORUS ANCEPS Peck.

MYCOLOGICAL NOTES FOR 1924[1]

L. O. Overholts

(With Plate 6 and 2 Text figures)

1. Cercospora Boehmeriae Peck.

Collected at Charter Oak, Huntingdon County, Pa., on *Boehmeria cylindrica*, fruiting on the lower surface of conspicuous brown areas. Peck describes the spots as numerous and minute, and the spores as 40–90 μ long. In my collection the spots are usually about 5 mm. broad, but sometimes twice that size, and the spores 40–126 × 3–4 μ. Under the microscope the spores are practically colorless or very dilutely colored. Professor Dearness has verified this determination.

2. Cladosporium cucumerinum Ellis & Arth.

This fungous parasite of the fruits of the cucumber (*Cucumis sativa*) seems not to have been often noted in the United States since its original discovery in 1889 (Bull. Agr. Exp. Sta. Ind. **19**: 8–10. 1889). It was sent in from Curtin, Pa., in October of the present year, and was evidently causing considerable damage. The exudation of a gummy amber-colored substance as noted both in the original account and in the description in Rabenhorst was well marked on my specimens. I find no conidiophores of the type illustrated by Humphrey who found the disease in Massachusetts in 1892 (Rep. Mass. Exp. Sta. **10**: 231. 1892). My spore records are 7–16 × 4–6 μ. The fungus is said to occur also on the leaves.

3. Gloeosporium Coryli (Desm.) Sacc.

When this fungus was first collected in 1919 it was referred to *Leptothyrium Coryli* Lib. This year it was again collected on

[1] These notes on new and little known fungi are a continuation of similar short papers begun in 1919 and published for that year in Mycologia **12**: 135–142. 1920; for the year 1920 in Bull. Torrey Club **49**: 163–173. 1922; for the year 1923 in Mycologia **17**: 108–112. 1925.

Contribution from the Department of Botany, The Pennsylvania State College, No. 52. Published by permission of the Director of the Agricultural Experiment Station.

leaves of both *Corylus rostrata* and *C. americana*, on the former host at Plainfield, Vt., and on the latter at Charter Oak, Pa. The fungus fruits rather abundantly on large, brown, conspicuous, though indefinite spots on the upper surface of the leaves. The fruiting body in young stages has the appearance of a dimidiate pycnidium. The nature of the black overlying wall is difficult to make out though it is usually quite conspicuous. It seems, however, not to be composed of fungous hyphae, but rather is the cuticle of the host blackened by the fungus. There is little doubt that these two species, though described independently, are in reality the same plant and best referable to *Gloeosporium*. The spores are oblong, hyaline, 10–15 × 4.5–6.5 μ. The fungus is definitely subcuticular in its origin. (PL. 6, FIG. 2, 3.)

4. MARSSONIA QUERCINA Wint.

Material of an anthracnose on *Quercus velutina* was collected at Charter Oak, Pa., during the season. When examined it was found to have *Marssonia*-like spores 15–27 × 2–2.5 μ, in epiphyllous acervuli, one to six on each small spot 1–4 mm. diameter. *M. Martini* Ellis & Ev., our most common species on *Quercus*, has hypophyllous acervuli with spores 12–15 μ long. Professor Dearness refers the specimen to *Gloeosporium septorioides* Sacc. var. *major* Ellis & Ev. and indicates *Marssonia quercina* Wint. as a possible synonym. Since in my collection the spores are definitely 2-celled with a conspicuous septum, I have filed it as *Marssonia quercina* var. *major* Ellis & Ev.

5. MONOCHAETIA TAPHRINICOLA (Ellis & Ev.) Sacc.

This year for the first time, in my experience, the lower surfaces of the deformed leaf areas caused by *Taphrina coerulescens* became blackish in color due to the development of the above species. The injury to the leaves seemed to be much extended over that produced by the *Taphrina* alone, so that large dead areas developed, sometimes affecting the entire leaf. The spores of the *Monochaetia* measure 18–21 × 6 μ. The effect of these two fungi was particularly severe in central Pennsylvania on *Quercus rubra*.

6. PHYLLOSTICTA CONFERTISSIMA Ellis & Ev.

This species was abundant this season in the same locality mentioned in my last report, namely, Charter Oak, Pa. A large number of small trees of *Ulmus americana* were found heavily infected so that many leaves were dropped early. Careful search was made for it on *Ulmus fulva* but without avail. In one spot there was discovered in mid-October an American elm with some infected leaves and within 10 feet of it a tree of *U. fulva* entirely free from infection. The fungus does not fruit until the leaves, or at least the leaf margins, begin to die and become brittle, and in no case does it appear to fruit before September.

7. PHYLLOSTICTA LAPPAE Sacc.

This species was collected on *Arctium* in Tioga County in northern Pennsylvania during the season. Seaver (N. Am. Fl. **6**: 32. 1922) records it only from Ohio and Ontario. Spores 6–9 × 2.5–3.5 μ.

8. SEPTORIA CORNI-MARIS Sacc.

The common *Septoria* spot of *Cornus* is caused by *S. cornicola*, while *S. canadensis* is occasionally found. Both have multiseptate spores 30–60 μ long. In this as well as in the character of the spots produced, two of my collections on *Cornus florida* from central Pennsylvania are entirely different. The spores here are 13–27 × 2–2.5 μ and 1- to 3-septate, and if one may judge from the description, the plant is otherwise sufficiently close to *S. Corni maris* Sacc. to be referred to that species. No specimens are available for comparison and I have seen no record of the occurrence of this species in America.

9. COCCOMYCES LUTESCENS Higgins [2]

I have seen no confirmation in the literature of certain phases of the work of Higgins on the *Cylindrosporium* spot of stone fruits.

During the past year I examined sections through the fruiting body of a *Cylindrosporium* collected at Walden, Vt., on *Prunus serotina*. According to the ideas of Higgins as set forth in the

[2] HIGGINS, B. B. Contribution to the life history and physiology of *Cylindrosporium* on stone fruits. Am. Jour. Bot. **1**: 145–173. 1914.

paper cited, this should be *C. lutescens*. The material showed the usual macroconidia, the microconidia described by Higgins, and the early stages in the development of the ascigerous stage. The first mentioned stage showed the usual characteristics assigned to the old *Cylindrosporium Padi* but in my sections I could not make out a definite stromatal layer to the hymenium as described by Higgins. The microconidial stage with bacilliform spores about $4 \times 1\ \mu$, in every case developed as an acervulus external to the internal stromatic mass, I judge will later develop into the ascocarp. Higgins relates that the microconidia seem to be produced from the same conidiophores as the macroconidia, but in no case did my preparations indicate this to be true. On the contrary they would seem to have been developed *de novo* with no relation to the other acervuli. It would appear that the ascigerous stromatal layer in the mesophyll of the leaf is developed about simultaneously with the microconidial acervulus just beneath the epidermis. There is a narrow zone of brown disintegrated host tissue separating these two bodies in nearly every instance. That macroconidia have not preceded the microconidia in the same acervuli seems clear not only from the fact that the microconidial acervuli are more superficial than the macroconidial ones and are considerably smaller as well, but also because I have seen numerous instances where the former are yet covered by the intact epidermis of the leaf though filled with the minute spores. Such could scarcely be the case if the pustule had originally produced the larger spores since in an acervulus at any stage of near maturity the epidermis is either pushed off or else breaks or tears when the section knife strikes it.

10. GNOMONIA RUBI Rehm.

In a large bramble patch of *Rubus allegheniensis* at Greensboro Bend, Vt., in August, the canes seemed to be dying out to a considerable extent. Search at the time failed to show that more than a small percentage of the death was caused by any of the usual bramble parasites. Later study of the material showed the presence of a fungus that seems identical with the above species as described by Edgerton (Bull. Torrey Club **34**: 593. 1907). This is the only record of the fungus I have seen in the

American literature. The spores seem often to be 4-celled, though perhaps falsely so due to the prominent oil globules in the lumen. They are produced 4 per ascus and measure 12–15 × 2.5–3 μ. (PL. 6, FIG. 1.) The extent of the parasitism of this fungus has not been determined in America.

11. PYRENOPEZIZA RUBI Rehm.

A species so referred by Professor Dearness was collected at the same time as *Gnomonia Rubi* at Greensboro Bend, Vt., and on the same host. My spore measurement records were 15–24 × 2 μ, considerably longer than reported by Rabenhorst (7–9 × 1.5–2.5 μ). (PL. 6, FIG. 4.)

12. RHYTISMA PUNCTATA (Pers.) Fr.

The usual hosts for this fungus are *Acer pennsylvanicum* and *A. spicatum* in central Pennsylvania. On both of these hosts it develops abundantly and as the leaves turn yellow in preparation for leaf fall the appearance this fungus presents is indeed striking. The chlorophyll remains in the infected area after it has disappeared from the surrounding tissue, so that the yellow of the general leaf tissue contrasts strongly with the green of the infected tissue and the black of the numerous gregarious fruiting bodies. This year the fungus was collected in quantity on *Acer Saccharum* at Charter Oak, Pa. I have never found it on *A. rubrum* though this species grows with both *A. spicatum* and *A. pennsylvanicum*. Even when these hosts grow side by side no infections have been found on *A. rubrum*.

13. TAPHRINA FILICINA Rost.

A collection on *Onoclea sensibilis* made near State College, Pa., in 1921 seems referable here and is noteworthy as the first report of a *Taphrina* or an *Exoascus* on *Onoclea*, outside of a little known occidental species recently described.

This species differs from collections on *Polystichum* previously referred to *T. lutescens* in having smaller asci and smaller spores, though Professor Dearness writes me that he has specimens of that species determined by Dr. Farlow with measurements about those of my collection, viz. 4–5 × 1.5–2 μ.

The following notes were made on this collection:

Spots elongate or irregular, the leaves not at all distorted, rusty-yellow, eventually the entire leaf assuming this color, visible from both surfaces, 2–3 × 0.5–2 mm., usually limited by the veinlets; hymenium hypophyllous, consisting of a continuous palisade of asci 21–30 μ long, 8-spored; spores narrow elliptic or fusoid, hyaline, 1-celled, 4–5 × 1.5–2 μ.

On fronds of *Onoclea sensibilis*.

The spots have the appearance of those caused by *Uredinopsis* on the same host. The asci are much shorter than those of *T. lutescens*.

14. POLYPORUS BETULINUS (Bull.) Fr.

Mr. C. R. Stillinger sends me this species from Metalline Falls, Wash., on *Betula papyrifera*. This is the first time this species has been recorded from west of Minnesota with the single exception of Weir's record from Montana.

15. PORIA SEMITINCTA (Peck) Cooke.

Since my first review of this species (N. Y. State Mus. Bull. **205–206**: 106–108. 1919) I have received and collected nearly twenty additional collections, showing it to be of rather common occurrence from Pennsylvania to North Carolina and west to Kentucky and Wisconsin. As previously described, clamp connections are usually absent, but as is probably true in most such cases, prolonged search will reveal a few such connections, at least in some parts of the fructification. In one collection from Asheville, N. C., I find a few rather prominent clamps and in a few cases clamps on two opposite sides of a hypha at the same septum, as shown in the illustration. This is the first time I

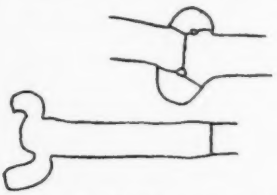


FIG. 1. *Poria semitincta*. Double clamp connections on the hyphae.

have seen this phenomenon, though I am of the opinion I have seen reference to it previously.

WITCHES BROOMS ON PRUNUS, ACER, AND PICEA

At Greensboro, Vt., a witches broom was found developing abundantly on *Prunus pennsylvanica* in August, 1925. Owing to the lateness of the season the brooms were largely defoliated and an exact determination of the causal fungus was impossible, but probably should be referred to *Taphrina Cerasi* (Fuckel) Sadebeck.

At State College, Pa., there has been noted for many years a broom on *Acer platanoides*. This year the broom was cut out in pruning the tree and the accompanying photograph secured (TEXT FIG. 2). No identification of the causal organism was made.

FIG. 2. Witches broom on *Acer plantanoides*. Greatly reduced.

In the little town of Beallsville, situated on the National Pike between Brownsville and Washington, Washington County, Pa., there may be seen an excellently developed broom on

Norway Spruce (*Picea excelsa*). No conjecture can be made as to the agency responsible for this broom, but the rarity of the occurrence of brooms on both *Acer* and *Picea* seems to render worth while this note of their occurrence.

17. CINTRACTIA JUNCI (Schw.) Trelease.

The fungus recorded in my 1923 Notes under the above name from Colorado is, I find, not that species but *Cintractia Caricis* (Pers.) Magn., and is on a filiform-leaved *Carex*, and not on *Juncus*.

PENNSYLVANIA STATE COLLEGE,
STATE COLLEGE, PA.

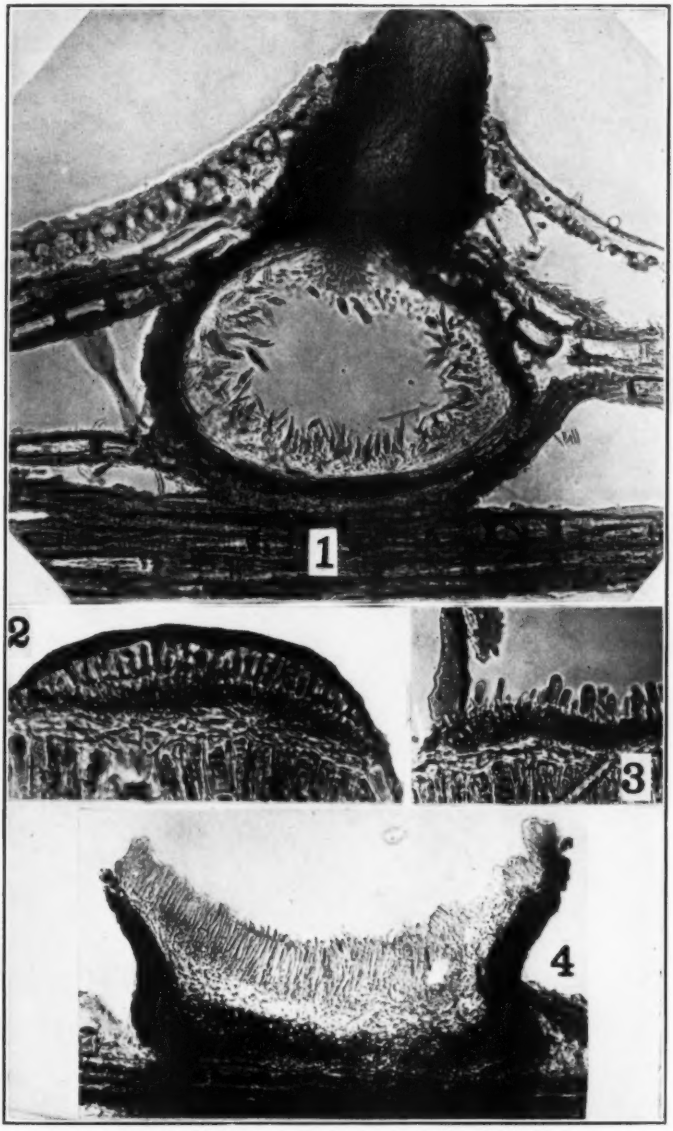
EXPLANATION OF PLATE 6

Fig. 1. Microphoto of free-hand vertical section through the perithecium of *Gnomonia Rubi*. × 220. Overholts Herb. *9411*.

Fig. 2. Microphoto of free-hand section through an acervulus of *Gloeosporium Coryli*, showing the unbroken cuticular covering. × 353. Overholts Herb. *9425*.

Fig. 3. Microphoto of free-hand sections of a portion of the acervulus with the covering torn off, and showing spores in position. × 820. Overholts Herb. *9425*.

Fig. 4. Microphoto of free-hand vertical section of apothecium of *Pyrenopeziza Rubi*. × 150. Overholts Herb. *9413*.



1. GNOMONIA RUBI
2, 3. GLOEOSPORIUM CORYLI
4. PYRENOPEZIZA RUBI

SOME NEW AND INTERESTING PORTO RICAN RUSTS

FRANK D. KERN AND H. H. WHETZEL

During the months of June and July, 1924, the writers visited Porto Rico on invitation of the Commissioner of Agriculture, Hon. Carlos E. Chardon, to assist in studies on the parasitic fungi of the Island. About 850 collections of fungi were brought back, all from Porto Rico except about 75 which were taken in Vieques, a small island lying off the east coast.

In making and studying these collections special attention has been given to the rusts. Numerous previous collectors, among whom may be mentioned Clinton (1904), Holway (1911), Whetzel and Olive (1916), Stevens (1913 and 1915), and Seaver and Chardon (1923), have furnished a basis for fairly extensive studies of the rusts of this island.

The rust flora of Porto Rico is better known than that of any other of the West Indian Islands. It is not a matter of surprise, therefore, that the great majority of the specimens collected during our comparatively brief exploration should be readily referable to previously recorded species. In our explorations made in 1924 the writers were accompanied on all collecting trips by Mr. R. A. Toro, assistant plant pathologist of the Insular Experiment Station at Rio Piedras. Commissioner Chardon was also with us on a number of the trips. Much credit for the success of the undertaking is due to Commissioner Chardon and to Mr. Toro. Their knowledge both of localities and of the native vegetation was of very material aid.

In addition to our collections there have been placed in our hands an extensive undetermined set of collections made in Porto Rico by Fred J. Seaver and Carlos E. Chardon, January 24 to April 5, 1923; a small set collected by G. P. Clinton in April 1904 and the private collections of C. M. Tucker, pathologist of the Federal Experiment Station at Mayaguez. These speci-

mens have been studied in connection with our own and some of them are discussed in the notes presented here.

In making our studies two papers by Dr. J. C. Arthur, Uredinales of Porto Rico, based on collections by F. L. Stevens (MYCOLOGIA **7**: 168–196, 227–255, 315–332. 1915; **8**: 16–33. 1916) and Uredinales of Porto Rico, based on collections by H. H. Whetzel and E. W. Olive (MYCOLOGIA **9**: 55–104. 1917), have been indispensable. We are also indebted to Dr. Arthur for suggestions and critical advice; to Professor H. S. Jackson of the Botany Department, Purdue University Agricultural Experiment Station, for access to the Arthur Herbarium, assistance in determining specimens and other courtesies; and to Dr. N. L. Britton, of the New York Botanical Garden, for determination of all the hosts.

UREDO

Uredo Campeliae sp. nov.

Uredinia chiefly hypophyllous, scattered, small, roundish or oval, 0.2–0.4 mm. across, rather long, covered by the epidermis, dingy yellow; urediniospores broadly ellipsoid, 22–27 × 29–32 μ, the wall pale yellow or colorless, thin, about 1.5 μ, sparsely and strongly echinulate with points 2–3 μ apart, the pores 2, equatorial.

On COMMELINACEAE:

Campelia Zanonia (L.) H.B.K. Hacienda Limon, near Villalba, July 14, 1924, *Whetzel, Kern & Toro 2475.*

This species differs from *Uromyces Commelinae*, *Puccinia Commelinae*, and *Uredo ochracea*, all of which occur on the same host family, in having pale yellow or colorless spores instead of brownish ones. It resembles *Uredo Commelyneae* in having colorless spore-walls but differs in the wall markings being sparsely and prominently echinulate instead of finely echinulate or verrucose-echinulate. The sori are noticeably whitish.

Uredo Rousseliae sp. nov.

Uredinia hypophyllous, numerous, scattered or crowded in small irregular groups, small, 0.1–0.2 mm. across, with imbricated incurved paraphyses united at their bases forming a pseudoperidium opening by a central pore, pale brown; urediniospores

broadly ellipsoid, 16–19 × 20–27 μ, the wall colorless, thin, 1–1.5 μ, finely and closely verrucose, the pores obscure.

On URTICACEAE:

Rousselia humilis (Sw.) Urban. Hacienda Limon, near Villalba, July 14, 1924, *Whetzel, Kern & Toro 2476.*

We have not found any species on the family Urticaceae at all comparable with this. Records of South American forms have been given special attention. The uredinia here described are of the *Cerotelium* or *Phakopsora* type as outlined for those genera by Arthur (Bull. Torrey Club **44**: 501–511. 1917), but they are not identical with any of the known species in these genera. The hemispherical pseudoperidium with the small central ostiole is characteristic.

Uredo Buchenaviae sp. nov.

Uredinia hypophyllous, few, scattered, very small, 0.1 mm. or less across, without peridium or paraphyses, long covered with the epidermis, punctiform, light yellowish-brown; urediniospores broadly ellipsoid or obovoid, often angular, 16–23 × 23–29 μ, the wall pale cinnamon-brown, 1–15 μ thick, moderately echinulate, the pores obscure, probably 2, equatorial.

On TERMINALIACEAE:

Buchenavia capitata (Vahl) Eichl. Reservoir road, near Guaynabo, June 23, 1924, *Whetzel, Kern & Toro 2477.*

We have found a report of but one rust on the family Terminaliaceae. P. Henning described *Uredo Byrsonimatis* on *Terminalia argentea* under the impression that his host was a *Byrsonima.* Later in correcting his error he proposed the name *U. Terminaliae* P. Henn. (Hedwigia **34**: 98 and 321. 1895). We have examined a part of the original specimen of the Henning species which was collected in Brazil by E. Ule. It differs from our specimen in having slightly larger spores, with paler, thicker walls, and with 4 or 5 evident equatorial germ pores. Our species is so very inconspicuous as to be easily overlooked.

Uredo guaynabensis sp. nov.

Uredinia hypophyllous, scattered, roundish or oval, 0.2–0.4 mm. across, tardily naked, light chestnut-brown; urediniospores

broadly ellipsoid or obovoid, often more or less irregular or angular, 18–23 × 24–32 μ (occasionally up to 37 μ long), the wall thin, about 1 μ, golden-brown, moderately echinulate, the pores 2, equatorial or superequatorial.

On ONAGRACEAE:

Jussiaea angustifolia Lam. (*J. suffruticosa* Authors not L.). Demonstration Farm, near Guaynabo, June 25, 1924, *Whetzel, Kern & Toro 2478*. (Also on *J. peruviana* L. from Isle of Pines, and *Jussiaea angustifolia* Lam. from Jamaica—see following note.)

Up to the present time no rust on *Jussiaea* has been described with a uredinial stage. On our material we find only uredinia. In his paper on "The Uredinales found upon Onagraceae" Bisby (Am. Jour. Bot. **3**: 555. 1916) mentions a phanerogamic specimen, *Jussiaea* sp., collected by N. L. Britton, marsh land near Ferry River, vicinity of Kingston, Jamaica, Sept. 11–12, 1906, No. *397*, as bearing a few uredinial sori. He remarks that this may be some other Onagraceous rust, as, for instance, *Uromyces plumbarius* Peck, but that he cannot be certain owing to the scanty material. We have examined the Jamaican specimen both as to rust and host and find it to be identical with ours. We have also examined a specimen on *Jussiaea peruviana* L. collected at Santa Fe, Isle of Pines, Cuba, by J. R. Johnson, No. *2547*, which belongs here. With these three specimens we have no hesitation in establishing a species. The pores are larger, thinner walled and have a different aspect from those of *Uromyces plumbarius* which is known only from the United States.

Uredo Borreriae (P. Henn.) nom. nov.

Uromyces Borreriae P. Henn. Hedwigia **35**: 227. 1896.

On RUBIACEAE:

Borreria verticillata (L.) G. F. W. Meyer. Near Rio Piedras, January 24 to April 5, 1923, *Seaver & Chardon 1309b, 2017b*.

The sori of this uredo-form occur intermixed with those of the short cycle *Puccinia lateritia* Berk. & Curt. P. Henning named *Uromyces Borreriae* from a specimen on *Borreria verticillata* from Rio de Janeiro, Brazil, July 1889, E. Ule, No. *688*. Henning

described one-celled teliospores of a *Uromyces* but H. & P. Sydow (Ann. Myc. **6**: 137. 1908) say the scanty original material contains only a uredo-form. The urediniospores of the Porto Rican specimens agree in size, color, markings and shape with the original description of Henning but the species is here listed as a *Uredo* owing to the great doubt regarding its relation to *Uromyces*. Dr. Arthur has pointed out to us the possibility of referring this form to *Uromyces Spermacoces* (Schw.) Curt. but differences in spore structure, hosts, and geographical distribution have deterred us from accepting the suggestion.

UREDO FARINOSA P. Henn. Hedwigia **36**: 216. 1897.

On LAURACEAE:

Ocotea leucoxylon (Sw.) Mez. Hacienda Maria, Yauco, June 17, 1924, *Whetzel, Kern & Toro 2479*.

This is one of the most conspicuous fungi collected on our trip. It causes striking dusty brown deformations of the inflorescence of this tree host. Almost every inflorescence on the tree was affected. Only a single tree bearing the fungus was found. Our material agrees so well with the original description of *Uredo farinosa* and also with the type material that there can be little if any doubt as to our determination. The type material is from Brazil on a member of the Lauraceae. The fungus is characterized by unusually small spores. It seems very doubtful where such a form as this is to be placed until its life-history is known. It was made the type of a new genus by Patouillard under the name *Clinoconidium farinosum* and referred to the Tuberculariaceae (Bull. Soc. Myc. France **14**: 156. See also Bull. Soc. Myc. France **30**: 445 and E. & P. Nat. Pfl. 1^2: 501).

AECIDIUM

AECIDIUM ABSEDENS Arth. Mycologia **7**: 315. 1915.

On RUBIACEAE:

Randia mitis L. (*Randia aculeata* L.).

Our field observations indicate that this *Aecidium* may be a stage of the grass rust, *Uromyces leptodermus* Syd., on species of *Lasiacis* and *Panicum*. Both the *Aecidium* and the grass rust are very common in Porto Rico. We found them most abundant where the respective host plants were in close association.

UROMYCES

UROMYCES BIDENTICOLA (P. Henn.) Arth. Mycologia **9**: 71. 1917.

Uredo Bidentis P. Henn. Hedwigia **35**: 251. 1896.

Uredo bidenticola P. Henn. Hedwigia **37**: 279. 1898.

Klebahnia Bidentis Arth. Mycologia **7**: 196. 1915.

On CARDUACEAE:

Bidens cynapiifolia H.B.K., *Chardon 1002*.

This appears to be a new host for this rust. A single collection by Chardon, Aug. 26, 1920, from Coamo, Porto Rico, is known to the writers.

UROMYCES CELOSIAE Diet. & Holw.; Holw. Bot. Gaz. **31**: 326. 1901.

Nigredo (?) *Celosiae* Arth. N. Am. Fl. **7**: 246. 1912.

On AMARANTHACEA:

Iresine Celosia L. Lapica, January 24 to April 5, 1923, *Seaver & Chardon 1556*.

This species has been known heretofore only from southern Mexico and Guatemala.

PUCCINIA

PUCCINIA CONSOBRINA Arth. & Holw.; Arth. Mycologia **10**: 129. 1918.

On CYPERACEAE:

Rynchospora corymbosa (L.) Britton. Porto Rico, January 25 to April 5, 1923, *Seaver & Chardon 1798*.

This species originally described from Costa Rica, known also from Jamaica, is represented in Porto Rico by the foregoing collection only.

PUCCINIA SORGHI Schw. Trans. Am. Phil. Soc. II. **4**: 295. 1832.

Dicaeoma Sorghi Kuntze, Rev. Gen. Pl. 3^3: 470. 1898.

Aecidium Oxalidis Thüm. Flora **59**: 425. 1876.

On POACEAE:

Zea Mays L. La Carmelita, April 18, 1904, *Clinton 130;* Mayaguez, April 23, 1923, *Tucker 286* (Cornell Univ. Fungi Porto Rico *2685*).

The first report of a rust on corn in Porto Rico was founded on a collection from Naguabo on the slope of El Duque by Mr. J. A. Stevenson in company with Dr. Olive in 1916. Dr. Arthur determined this rust to be *Uredo pallida* Diet. & Holw. *Zea Mays* was a new host for that rust which had previously been known only on *Tripsacum lanceolatum*. The writers collected a rust on corn at the Trujilla Alta Demonstration Farm, June 26, 1924, which is also *Uredo pallida* or, as it is now known, *Puccinia pallescens* Arth. since the discovery of its telial stage (Bull. Torrey Club **46**: 111. 1919). *Puccinia pallida* Tracy, 1893, is a different species. The collections by Clinton, 1904 and by Tucker, 1923, listed above are without doubt the ordinary corn rust, *Puccinia Sorghi*, and this is the first published report of its occurrence in Porto Rico.

MILESIA

MILESIA AUSTRALIS Arth. Bull. Torrey Club **51**: 53. 1924.

Uredo Blechni Diet. & Neger, Bot. Jahrb. **22**: 358. 1896. (Not *Milesia Blechni* Arth. 1922.)

On POLYPODIACEAE:

Blechnum occidentale L. Finca Maria, Yauco, June 19, 1924. *Whetzel, Kern & Toro 2295*, and Rio Prieto, Yauco-Lares Road, June 20, 1924. *2296*.

Polytaenium lanceolatum (L.) Benedict (*Antrophyum lanceolatum* Kef.) N. Y. Bot. Gard., *Sintenis 1800b*.

This is the first report of this species from North America. An earlier collection on *Lygodium polymorphum* by P. C. Standley from Salvador is referred in the Arthur Herbarium to this species. The same fungus is reported from Trinidad on *L. polymorphum*. The Salvador and Trinidad specimens do not agree as well with the type as does the Porto Rican material. The type collection is from Concepcion, Peru, May 1896, on *Blechnum hastatum*. The rust on *Polytaenium lanceolatum* was discovered on a Sintenis specimen, *1800*, in the N. Y. Bot. Gard. herbarium. Dr. Arthur, who examined the material, refers it provisionally to this species.

DESMELLA

DESMELLA SUPERFICIALIS (Speg.) Syd. Ann. Myc. **16**: 242. 1918.
Caeoma superficialis Speg. An. Soc. Ci. Argent. **17**: 96. 1884.
Uredo superficialis De Toni in Sacc. Syll. Fung. **7**: 865. 1888.
Uredo Gymnogrammes P. Henn. Hedwigia **34**: 337. 1895.
Desmella Gymnogrammes Syd. Ann. Myc. **16**: 242. 1918.

On POLYPODIACEAE:

Dennstaedtia rubiginosa (Kaulf.) Moore. Rio Prieto, Yauco-Lares Road, June 20, 1924, *Whetzel, Kern & Toro 2302.*

Dryopteris tetragonia (Sw.) Urban. Finca Limon, Villalba, July 14, 1924, *Whetzel, Kern & Toro 2299;* Rio Prieto, Yauco-Lares Road, June 20, 1924, *2297.*

This rust is common in the higher mountain regions of Porto Rico. It has been referred to previously under the name *Uredo Gymnogrammes* which is now regarded as a synonym according to the foregoing arrangement. The two hosts here listed are new ones for the rust. The uredinia are really subepidermal forming beneath the stomata and protruding in tufts thus appearing superficial. It may possibly be heteroecious.

CEROTELIUM

CEROTELIUM DESMIUM (Berk. & Br.) Arth. N. A. Fl. **7**: 698. 1925.
Aecidium desmium Berk. & Br. Jour. Linn. Soc. **14**: 95. 1875.
Uredo Gossypii Lagerh. Jour. Myc. **7**: 48. 1891.
Kuehneola Gossypii Arth. N. Am. Fl. **7**: 187. 1912.
Cerotelium Gossypii Arth. Bull. Torrey Club **44**: 510. 1917.

On MALVACEAE:

Montezuma speciosissima Sessé & Moc. (*Thespesia grandiflora* DC.). Rio Prieto, Yauco-Lares Road, June 20, 1924. *Whetzel, Kern & Toro 2261;* Ciales Road, July 20, 1924. *2402.*

This is the first report of a rust on this interesting host. The genus *Montezuma* has but two species, the one here listed is endemic in Porto Rico; the other is Cuban. The Porto Rican species is commonly planted as a roadside shade tree. The rust is unquestionably the cotton rust, common on tree cottons and the cultivated sea island cotton throughout Porto Rico.

CEROTELIUM ALIENUM (Syd. & Butler) Arth. N. Am. Fl. **7**: 698. 1925.

Uredo Spondiadis Petch, Ann. Bot. Gard. Peradeniya **5**: 248 1912.

Kuehneola aliena Syd. & Butler; Sydow, Monog. Ured. **3**: 322. 1914.

Cerotelium Spondiadis (Petch) Arth. Bull. Torrey Club **44**: 510. 1917.

On ANACARDIACEAE:

Spondias Mombin L. Near Manati, March 30, 1923, *Seaver & Chardon 2065.*

This is the first collection of this species in North America.

PROSPODIUM

PROSPODIUM TUBERCULATUM (Speg.) Arth. N. Am. Fl. **7**: 161. 1912.

Uredo tuberculata Speg. An. Soc. Ci. Argent. **9**: 172. 1880.

Puccinia tuberculata Speg. An. Soc. Ci. Argent. **10**: 11. 1880.

On VERBENACEAE:

Lantana Camara L. Martin Peña, January 28, 1923, *Seaver & Chardon 1369.*

This is the first collection of this rust in Porto Rico. It is known from central Mexico and has been reported also from Cuba. Only urediniospores have been found on this material but they agree so well with the other collections that there can be no doubt about their identity

RAVENELIA

RAVENELIA PITHECOLOBII Arth. Bot. Gaz. **39**: 394. 1905.

On MIMOSACEAE:

Pithecellobium Unguis-cati (L.) Mart. Vieques, July 17, 1924, *Whetzel, Kern & Toro 2101.*

This single collection from Porto Rico is the only one recorded from this region. Heretofore this rust has been reported from southern Florida, central Mexico and Cuba.

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NOTES AND BRIEF ARTICLES

(UNSIGNED NOTES ARE BY THE EDITOR)

The New York Botanical Garden was recently favored with a lecture from Professor H. H. Whetzel on the subject "Keeping Plants in the Gardens and Borders Healthy." During his visit Professor Whetzel also spent some time in the Mycological Herbarium.

The recent death of Professor Ellsworth Bethel of Denver, Colorado, has removed another enthusiastic mycologist. For many years Professor Bethel has been a tireless field worker in this line and our own herbarium is dotted through with specimens collected by him. Several years ago we had the privilege of spending considerable time roaming through the Rocky Mountains in search of fungi with him. His death therefore is more or less of a personal loss to us. A more extended note will appear in a later issue.

Mycologists will welcome the appearance of the twenty-third volume of Saccardo's "Sylloge Fungorum," which is being brought to completion by Alex. Trotter and others. This volume contains a photograph of P. A. Saccardo who has done so much in perfecting this extensive and valuable index. It is a satisfaction to know that since his death in 1906 the work is being carried on by his successors. This volume consists of an index to the Basidiomycetes including the rusts and smuts which have been published since the appearance of volume twenty-two in 1913. It contains a record of a large number of American species and will therefore be most useful to American mycologists.

PRELIMINARY NOTE ON THE GENUS CHRYSOPSORA

The rust genus *Chrysopsora* was founded by Lagerheim [1] in 1891 with one species *C. Gymnoxidis* Lag. as the type and has

[1] Ber. Deutsch. Bot. Ges. **9**: 345. 1891.

remained monotypic till 1924 when Arthur [2] added two species *C. Cestri* (P. Henn.) Arth. and *C. Mikaniae* Arth. *Chrysopsora* is characterized by having bright orange sori with long pedicelled teliospores which at first appear to be like *Puccinia*. The spores however have no germ pores and each cell at germination develops three internal cross walls and from each cell thus formed a sterigma is developed on which is borne the sporidium. The germination is similar to *Coleosporium* and *Goplania*. The spore wall is firm and of appreciable thickness.

While studying the Holway rust collections made in South America all three species of *Chrysopsora* have been encountered and a preliminary study reveals that *C. Mikaniae* and *C. Cestri* cannot properly be considered to belong to that genus. In *C. Mikaniae* no *Puccinia*-like stage is evident except in the very young unopened sori. There is a gradual development from a small colorless two-celled stage with no sharp differentiation between spore cell and promycelium. The upper cell gradually elongates and the lower cell simultaneously develops at one side in like manner, giving the structure a shape like a mitten in which the thumb is as large as the hand portion, both being cylindric. When fully mature the contents concentrate in the upper portion of each branch, leaving the lower portion empty and collapsed. Cross walls develop in the upper part as in typical promycelia and sterigmata and sporidia are developed in the usual way. In *C. Cestri* and another undescribed species on *Mikania*, there is an evident *Puccinia*-like stage. The spores have no localized pores and the promycelia develop by the elongation of the cells. The subsequent development is similar to that described above. All species are accompanied by pycnia.

To accommodate these forms the genus **Holwayella** is proposed in honor of Mrs. Mary M. Holway who accompanied Prof. Holway on his South American trips and who has given generously of her time in arranging and caring for the collections. The type species is **Holwayella Mikaniae** (Arth.) n. comb. A more detailed account with descriptions and illustrations is in preparation and will be published in connection with studies of other important South American rusts.

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[2] Bull. Torrey Club **51**: 53–54. 1924.